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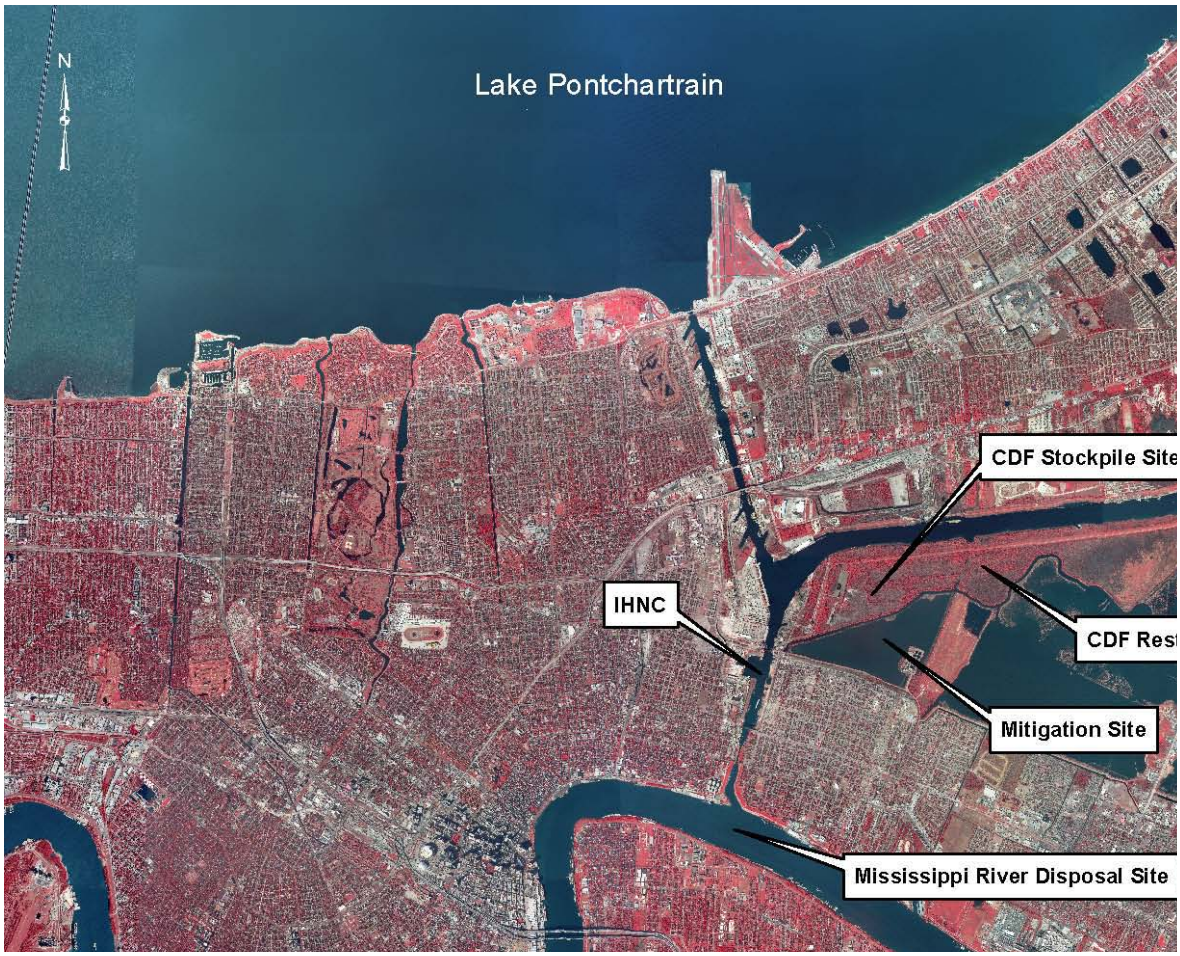
August 2011



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Final report

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Abstract: The U.S. Army Corps of Engineers, New Orleans District has been authorized by Congress to replace the existing Industrial Canal Lock. The existing lock has been in operation since 1921, and a new, larger lock would accommodate a heavier traffic load and modern deep-draft vessels. As part of the construction project, sediment and soil from the area will be dredged to accommodate the new lock, allow ship traffic to bypass the construction site, and deepen the current channel through the Inner Harbor Navigation Canal (IHNC). This document summarizes the sediment characterization and environmental analysis conducted in support of the IHNC lock replacement dredging project.

Contents

Figures and Tables

Figures

Tables

Preface

This technical report, *Water Quality and Sediment Evaluation for Inner Harbor Navigation Canal Lock Replacement Project, New Orleans, Louisiana,* was prepared by the U.S. Army Corps of Engineers (USACE) Environmental Laboratory (EL), Engineer Research and Development Center (ERDC), Vicksburg, MS and the U.S. Army Engineer (USAE) District, New Orleans, New Orleans, LA. This document summarizes sediment characterization and environmental analysis conducted in support of the IHNC lock replacement dredging project. The document was prepared for the USAE District, New Orleans under Customer Order No. W42HEM7179001.

This report was written by Drs. Guilherme R. Lotufo, Trudy J. Estes, and Paul R. Schroeder, of the Environmental Processes and Engineering Division (EPED), Environmental Laboratory (EL), ERDC, and Mrs. Jeff M. Corbino, Eric J. Glisch and Rodney F. Mach, of the USAE District, New Orleans.

Director of ERDC-EL was Dr. Elizabeth C. Fleming. Commander and Executive Director of ERDC was COL Gary E. Johnston. Director was Dr. Jeffery P. Holland.

Unit Conversion Factors

Multiply	By	To Obtain
acres	4,046.873	square meters
cubic feet	0.02831685	cubic meters
feet	0.3048	meters
inches	0.0254	meters
ounces (mass)	0.02834952	kilograms
ounces (U.S. fluid)	2.957353 E-05	cubic meters

1 Introduction

Purpose

The U.S. Army Engineer District, New Orleans (CEMVN) has been authorized by Congress to replace the existing Industrial Canal Lock. A larger lock would replace the existing lock, which has been in operation since 1921, to accommodate a heavier traffic load and modern deep-draft vessels. As part of the construction project, sediment and soil from the area would be dredged to accommodate the new lock, allow ship traffic to bypass the construction site, and deepen the current channel through the Inner Harbor Navigation Canal (IHNC).

Samples of the sediment and soil that would be excavated as part of the lock replacement project have been evaluated in accordance with section 404 of the Clean Water Act. As stated in 40 Code of Federal Regulations Part 230 – *Section 404(b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material*, the CEMVN must demonstrate that the proposed discharges of dredged material associated with the lock replacement project would not have unacceptable adverse impacts on the physical, chemical, and biological components of the aquatic environment. A series of tests have been performed on the proposed dredged material as described in the *Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S. – Testing Manual* (U.S. Environmental Protection Agency (USEPA / U.S. Army Corps of Engineers (USACE) 1998). This document is commonly referred to as the "Inland Testing Manual" (ITM). Test methodologies and detailed results are described in a report by Weston Solutions (2008) and its appendices. This document is available at the following website (Appendix C of the FINAL IHNC Lock SEIS file):
http://www.mvn.usace.army.mil/pd/projectsList/reports.asp?projectID=107&projectP2=108785

In addition, a DVD that includes all of the appendices associated with this report is available upon request. To obtain a copy of the DVD, please contact:

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The interpretations of the results of those tests, along with an environmentally acceptable dredged material disposal plan, are provided in this report.

Dredged material sampling and analysis overview

Dredging area

Dredging would be required to accommodate seven project features: (1) a navigable bypass channel north of the existing lock and adjacent to the new lock construction site (referred to as the "north bypass channel"), (2) the new lock construction site, (3) IHNC channel enlargement north of the new lock, (4) IHNC channel enlargement south of the new lock and north of the existing lock, (5) a navigable bypass channel adjacent to the existing lock (referred to as the "south bypass channel"), (6) existing lock demolition and IHNC channel enlargement south to the St. Claude Ave. Bridge, and (7) IHNC channel enlargement south of St. Claude Ave. to the Mississippi River.

Project features overlay three general sediment and soil types within the project area: (1) non-native sediment consisting of unconsolidated material that has been deposited naturally within the IHNC since it was constructed in the 1920s, (2) non-native fill consisting of material that has been placed adjacent to the IHNC for industrial development since the IHNC was constructed, and (3) native subsurface soil consisting of clays and alluvial formations at or below the depth of the original IHNC cut and underlying fill material along the banklines of the IHNC (Figure 1). In this report, project DMMU sediment and soil types (1), (2) and (3) are designated as "NN," "F," and "N."

Project features also overlap areas impacted by industrial activities along the IHNC, including a former industrial area where contaminated soils have since been remediated. After a review of prior reports, studies, and contaminant sampling programs, suspected areas of contamination were defined within (1) a segment of the IHNC north of the Florida Ave. Bridge and adjacent to a metal scrap yard, (2) a remediated industrial area, formerly known as the East Bank Industrial Area, located between the Florida and Claiborne Ave. Bridges, and (3) an abandoned wharf along the west bank of the IHNC near Galvez Street. Appendix A summarizes contaminant reports and includes a list of suspected contaminants with analytical target detection limits developed for the IHNC Lock Replacement Project analytical program.

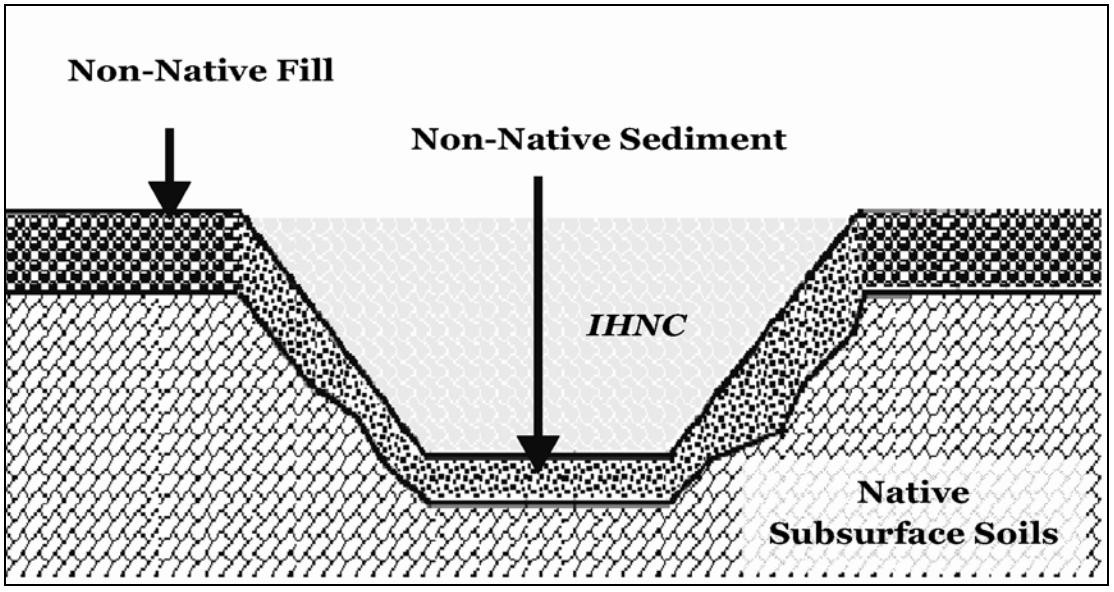

Figure 1. Sediment and soil types within the project area.

Based on the location and dimension of the project features and overlap with sediment types and suspected areas of contamination, the project area was divided into 11 non-native sediment dredged material management units (DMMUs), four non-native fill DMMUs, and five native subsurface soil DMMUs. Two to 16 sediment samples were collected from each DMMU (depending on the size of the dredging unit) and subjected to chemical, physical, and biological tests. Table 1 details the breakdown of DMMUs into vertical and horizontal units by project feature, and Figure 2 depicts the spatial arrangement of DMMUs including individual sampling sites for each DMMU. DMMU 11 was eliminated from the sampling and analysis program after soundings determined the area was already at project depth. Results from sediment and soil tests were used to characterize each DMMU and determine acceptable disposal options for each dredging unit.

Disposal areas

Two open-water disposal areas have been proposed for dredged material excavated as part of the lock replacement project (Figures 3 and 4). An area of deep water in the Mississippi River adjacent to the IHNC would serve as a primary disposal site. A secondary disposal site is located northeast of the IHNC in a triangular area of subsided marsh bounded by Bayou Bienvenue, an Orleans Parish sewage treatment plant, and the 9th Ward back protection levee. Dredged material would be discharged unconfined into the Mississippi River disposal site and is expected to disperse. Material would be placed semi-confined into the secondary disposal site to create a sub-aerial platform at typical marsh elevations. It is anticipated that wetland

plants would colonize this platform and that the disposal site would transform into a functioning marsh. This newly created marsh would offset or mitigate for unavoidable losses of other wetland areas associated with the lock replacement project and is therefore referred to in this report as the "mitigation site." Chemical and physical analyses were conducted on sediment and water samples representative of each disposal area to characterize the sites and for comparison to materials collected from the DMMUs. Samples were taken from within the disposal areas and from adjacent "reference" areas previously not directly impacted by dredged material placement (Mississippi River upstream of the IHNC and Saint Bernard central wetlands).

Table 1. IHNC DMMUs and associated project features.[1]

DMMUs	Associated Project Feature
Non-Native Sediments	
DMMU 1 NN	IHNC Channel Enlargement
DMMU 2 NN	IHNC Channel Enlargement
DMMU 3 NN	New Lock Construction
DMMU 4 NN	New Lock Construction
DMMU 5 NN	New Lock Construction
DMMU 6 NN	North Bypass Channel
DMMU 7 NN	North Bypass Channel
DMMU 8 NN	IHNC Channel Enlargement
DMMU 9 NN	Lock Demolition and IHNC Channel Enlargement
DMMU 10 NN	South Bypass Channel
DMMU 11 NN	IHNC Channel Enlargement
Non-Native Fill	
DMMU 3 F	New Lock Construction
DMMU 6 F	North Bypass Channel
DMMU 7 F	North Bypass Channel
DMMU 10 F	South Bypass Channel
Native Subsurface Soils	
DMMU 3 N	New Lock Construction
DMMU 4/5 N[2]	New Lock Construction
DMMU 6 N	North Bypass Channel
DMMU 7 N	North Bypass Channel
DMMU 10 N	South Bypass Channel

[1]Note that non-native sediments occur within the channel, non-native fill is located on the channel banks, and native subsurface soils underlay non-native sediments and soils.

[2]DMMU 4/5 N underlays both DMMUs 4 NN and 5 NN.

Figure 2. Plan view of the IHNC Lock Replacement Project and distribution of major DMMUs. Sediment sampling sites appear as red dots within each DMMU. Note that proposed sampling stations in DMMU 11 were below project depth, and samples were therefore not collected as part of this sediment evaluation. Native subsurface soil DMMUs (3N, 4/5N, 6N, 7N, 10N) underlay non-native sediments within the IHNC and non-native fill DMMUs on the channel banks.

Figure 3. Proposed disposal areas.

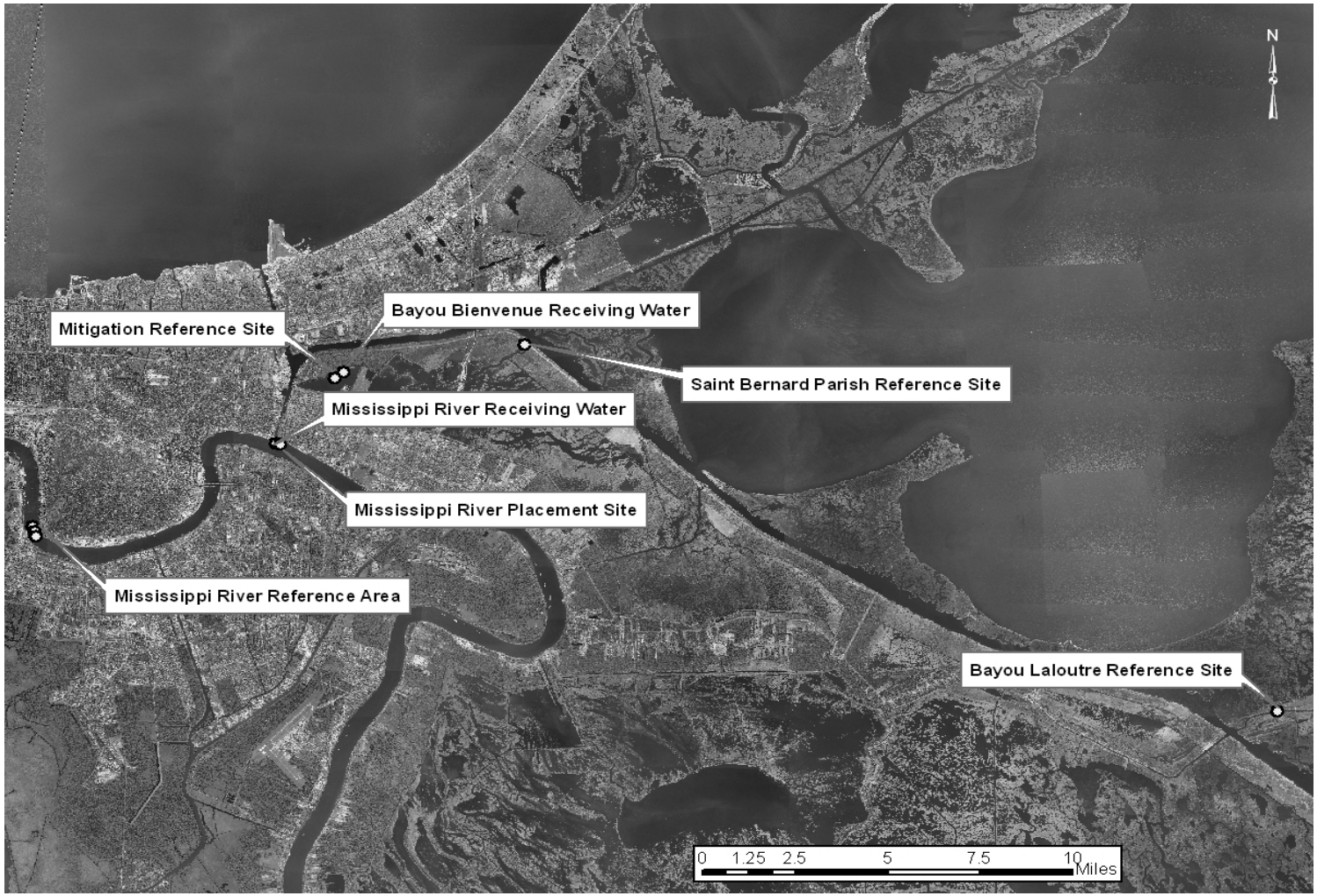

Figure 4. Disposal and reference areas sediment, water, and soil collection sites.

In addition, an upland confined disposal facility (CDF) has been proposed to accommodate dredged material that has either been determined by this evaluation to be unsuitable for discharge into open water or that would be temporarily stockpiled and later utilized as backfill around the lock construction site (Figures 3 and 4). The CDF is located in an area bounded by the north bank of Bayou Bienvenue and the Chalmette Loop hurricane protection levee on the south bank of the Gulf Intracoastal Waterway (GIWW), near the intersection of the IHNC and GIWW. Discharges of effluent and runoff from the CDF would likely be routed to the GIWW or Bayou Bienvenue, and design considerations for managing these discharges have been included in this evaluation. Chemical analysis was conducted on water samples collected from the GIWW and Bayou Bienvenue to characterize potential receiving waters for effluent and runoff from the CDF. Soil samples were also collected for analysis from a reference area near the project area that was previously not directly impacted by dredged material placement (Bayou LaLoutre Ridge near Hopedale).

Evaluation of sediment physical and chemical properties

Physical and chemical properties of project sediments were measured to characterize and make general comparisons between DMMUs and disposal areas. Physical properties of project sediments were measured, including grain-size distribution, moisture content, and organic content. Sediments were analyzed for the presence of over 170 contaminants of concern (COC), including metals, organotins, polychlorinated biphenyls (PCB), semi-volatiles, total petroleum hydrocarbons (TPH), pesticides, herbicides, and volatiles (Weston Solutions 2008). Physical characterization and chemical inventories were used in the interpretation of biological tests (described below) and to identify sediment properties that may have contributed to observed adverse impacts to water column and benthic test organisms.

Biological evaluation

Freshwater and estuarine biology of water column and benthic impacts were evaluated separately. Water column, benthic toxicity, and bioaccumulation testing are described in detail in Weston Solutions (2008, http://www.mvn.usace.army.mil/pd/projectsList/reports.asp?projectID=-107&projectP2=108785 (Appendix C of the FINAL IHNC Lock SEIS file), along with test results. A DVD that includes all of the appendices associated with this report is available upon request. To obtain a copy of the DVD, contact:

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Sediments and soils were used for the preparation of elutriates (mixture of sediment and site water representative of dredged material slurry) used in freshwater and estuarine suspended phase toxicity tests and for conducting freshwater and estuarine solid phase toxicity and bioaccumulation tests. The sediments and soils are listed and described in Table 2.

Table 2. Soils and sediments used in the biological evaluation.

Soil or Sediment	Description
DMMU 1 NN	Composite of DMMU 1 non-native sediments from 6 locations
DMMU 2 NN	Composite of DMMU 2 non-native sediments from 6 locations
DMMU 3 NN	Composite of DMMU 3 non-native sediments from 3 locations
DMMU 3 N	Composite of DMMU 3 native subsurface soils from 6 locations
DMMU 3 F	Composite of DMMU 3 non-native fill from 3 locations
DMMU 4 NN	Composite of DMMU 4 non-native sediments from 8 locations
DMMU 5 NN	Composite of DMMU 8 non-native sediments from 8 locations
DMMU 4/5 N	Composite of DMMUs 4 and 5 native subsurface soils from 15 locations
DMMU 6 NN	Composite of DMMU 6 non-native sediments from 2 locations
DMMU 6 N	Composite of DMMU 6 native subsurface soils from 6 locations
DMMU 6 F	Composite of DMMU 6 fill from 4 locations
DMMU 7 NN	Composite of DMMU 8 non-native sediments from 4 locations
DMMU 7 N	Composite of DMMU 7 native subsurface soils from 6 locations
DMMU 7 F	Composite of DMMU 7 fill from 5 locations
DMMU 8 NN	Composite of DMMU 8 non-native sediments from 4 locations
DMMU 9-1 NN	Composite of DMMU 9 non-native sediments from 1 location south of existing lock
DMMU 9-2,4 NN	Composite of DMMU 9 non-native sediments from 2 locations north of existing lock
DMMU 10 NN	DMMU 10 non-native sediments from 1 location
DMMU 10 N	Composite of DMMU 10 native subsurface soils from 2 locations
DMMU 10 F	Composite of DMMU 10 fill from 2 locations
MR	Non-native sediments from Mississippi River reference area
SB	Non-native sediments from San Bernard Parish reference area
MIT	Non-native sediments from mitigation site

Evaluating water column impacts

Potential impacts to disposal area receiving waters during the placement of dredged material were assessed through comparison of elutriate concentration to water quality standards and background levels in

receiving waters and through biological testing with sensitive aquatic organisms. Elutriate composites prepared for biological evaluation are listed in Table 2. Comparisons of elutriate concentration to criteria and background levels are summarized in Appendix A of Weston Solutions (2008). Freshwater and estuarine juvenile fish were exposed to elutriates to predict any potential water column toxicity at the Mississippi River and mitigation site, respectively. Dilution requirements were determined for each elutriate COC to meet background levels, or site-specific and regulatory water quality standards. Using results from elutriate toxicity tests, site-specific dilution requirements were developed for COC that lack state or Federal water quality standards. Maximum dilution required for each DMMU to meet the above criteria at each disposal area was identified, and mixing zone models were evaluated to determine if sufficient dilution occurred within regulatory mixing zones specified by the Louisiana Department of Environmental Quality.

Elutriates from DMMUs meeting required dilutions within regulatory mixing zones were predicted not to be potentially toxic to water column organisms at a given disposal site. Typically, elutriates exceeding required dilutions beyond the mixing zone are predicted to be potentially toxic to water column organisms. When predicted, toxicity can provide a basis for eliminating disposal alternatives for a DMMU. In cases where toxicity was not observed in estuarine fish exposed to an elutriate treatment, but state or Federal water quality standards were exceeded beyond the mixing zone, DMMUs were further evaluated as a potential source of material for the mitigation site.

Evaluating benthic impacts

Potential impacts to the benthos at disposal areas after placement of dredged material were assessed through direct exposure of sensitive benthic organisms to dredged material and analysis of COC bioaccumulated in tissues of organisms exposed to DMMU and disposal reference sediments. Freshwater and estuarine amphipods were exposed to DMMU and disposal area reference sediments to predict any potential benthic toxicity following dredged material placement at the Mississippi River and mitigation site. For any DMMU exposure resulting in statistically significant mortality exceeding a disposal area reference, the dredged material is predicted to be acutely toxic to benthic organisms at a given disposal site. When predicted, acute toxicity provided a basis for eliminating disposal alternatives for a DMMU. Similar statistical analysis was performed on

freshwater and marine clams to compare bioaccumulation of COC in organisms exposed to DMMU and reference sediments. Where statistically significant bioaccumulation was observed, consideration was given to the concentration of the contaminant relative to U.S. Food and Drug Administration (USFDA) Action Levels (and other action or tolerance level or state advisory), the toxicological importance of the contaminant, potential for the contaminant to biomagnify, the magnitude of exceedance above the reference, and the number of COC exceeding the reference.

2 Sediment Characterization

Physical trends are presented in Table 3 and display variation in grain size, moisture content, and organic carbon content. A simple description of physical trends accompanies the table, but does not attempt to classify project sediments based on physical properties. COC levels detected in sediment samples are summarized in Tables 4 - 19 as a range of values observed for each DMMU and individual values observed at disposal and reference areas. However, it is difficult to discern patterns in this large data set by simple review of the tables. Figures 5 - 11 display general trends among sediment and soil types within the project area and serve as a guide while reviewing sediment chemistry tables.

Physical trends

Non-native sediments can be characterized generally as fine-grained material with high moisture content. Combined clay and silt fractions were typically greater than 87%. With the exception of DMMUs 4 and 7 NN, coarse-grained material accounted for less then 12% of the sediment. DMMUs 4 and 7 NN had roughly equal proportions of sand, silt, and clay. Moisture content ranged between 37 and 58%. By weight, organic carbon content in non-native sediments was variable and ranged from 11,700 to 29,100 mg/kg of organic carbon.

Grain-size distribution in non-native fill materials was less consistent. Coarse-grained material in DMMUs 3 F and 10 F was greater than 50%, while DMMUs 6 F and 7 F had a greater percentage of fine-grained material (96 and 74%, respectively). Organic carbon content varied from 9,270 to 25,300 mg/kg for those DMMUs. Moisture content ranged between 27 and 33%. Differences in physical characteristics of fill are likely attributable to available sources of material at the time of construction or differences in construction specifications.

Native subsurface soils had fairly uniform grain size and moisture content. Combined clay and silt fractions ranged between 84 and 96%, and moisture content averaged about 38%. However, organic carbon content varied considerably (7,590 to 44,300 mg/kg). Major coarse-grained alluvial deposits were not apparent, although sand fractions were somewhat greater in DMMUs 3, 4/5, and 10 N.

There are considerable differences in physical properties of sediments in the Mississippi River and mitigation site disposal areas. Mississippi River sediments were predominantly coarse-grained (57% sand) with a lower moisture content (34%), while mitigation site sediments were predominantly fine-grained (96% clay and silt) with a high moisture content (82%). Organic carbon content was 10,300 and 164,000 mg/kg, respectively, at the Mississippi River and mitigation site.

Table 3. Physical properties of DMMUs and Reference Areas

Area	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Moisture (%)	Organic Carbon (mg/kg)
Non-Native Sediment						
DMMU 1 NN	53.8	37.3	8.9	0	57.6	29,100
DMMU 2 NN	65.1	25.7	6	3.1	54.1	20,100
DMMU 3 NN	66.1	30.9	2.8	0.2	55.6	21,100
DMMU 4 NN	40.6	26.9	30.8	1.7	53.5	16,100
DMMU 5 NN	56	32.7	11	0.3	48.5	21,600
DMMU 6 NN	42.1	45.4	6.8	5.7	37.2	19,800
DMMU 7 NN	33.3	34.7	31.6	0.4	54	17,700
DMMU 8 NN	60.8	37.1	2.1	0	51.9	18,600
DMMU 9 NN	49.3	41.9	8.6	0.2	42.4	12,700
DMMU 10 NN	50.1	46.2	2.4	1.3	39	11,700
Non-Native Fill						
DMMU 3 F	12.4	29	57.1	1.5	26.7	10,900
DMMU 6 F	61.4	34.4	3.6	0.6	32.9	17,500
DMMU 7 F	31.6	42	16.5	9.9	29.7	25,300
DMMU 10 F	30.2	19.7	49	1.1	26.5	9,270
Native Subsurface Soil						
DMMU 3 N	43.8	40	12.2	4	35.7	33,100
DMMU 4/5 N	41.1	49	9.9	0	32.6	7,590
DMMU 6 N	59.3	36.5	3.4	0.8	39.7	26,900
DMMU 7 N	61.3	34.9	3.8	0	44.8	44,300
DMMU 10 N	46.6	43.1	10.1	0.2	34.9	12,200
Reference Areas						
Mississippi River Reference	12.4	29	57.1	1.5	33.9	10,300
Mitigation Site Reference	61.4	34.4	3.6	0.6	82	164,000

Table 4. Detected metals in non-native sediments (mg/kg).

Analyte	DMMU 1 NN	DMMU 2 NN	DMMU 3 NN	DMMU 4 NN	DMMU 5 NN
Aluminum	8,200 - 13,900 (11,633)	12,400 - 15,500 (14,017)	13,600 - 20,600 (17,833)	6,050 - 16,200 (10,018)	2,190 - 16,600 (11,006)
Antimony	0.07 - 0.21 (0.14)	0.08 - 0.23 (0.13)	0.10 - 0.13 (0.12)	0.06 - 0.56 (0.18)	0.05 - 0.17 (0.11)
Arsenic	5.7 - 8.6 (7.0)	7.2 - 8.1 (7.5)	7.1 - 9.0 (8.3)	4.0 - 8.4 (6.3)	2.7 - 7.9 (6.6)
Barium	212 - 2,000 (1,211)	381 - 889 (712)	376 - 989 (752)	368 - 1,390 (1,005)	124 - 1,170 (594)
Beryllium	0.56 - 0.86 (0.75)	0.76 - 0.92 (0.87)	0.96 - 1.2 (1.1)	0.43 - 1.0 (0.67)	0.15 - 1.1 (0.75)
Cadmium	0.37 - 1.4 (0.86)	0.65 - 0.91 (0.76)	0.72 - 1.1 (0.94)	0.39 - 0.86 (0.68)	0.15 - 1.1 (0.65)
Calcium	6,530 - 8,410 (7,542)	6,400 - 23,900 (10,667)	6,280 - 10,400 (7,870)	4,190 - 10,600 (7,010)	5,850 - 10,700 (8,486)
Chromium	14.0 - 29.2 (22.1)	21.8 - 38.5 (26.5)	23.8 - 34.2 (30.7)	14.0 - 49.5 (26.7)	11.5 - 35.5 (23.0)
Copper	18.8 - 57.4 (39.2)	29.4 - 42.0 (33.9)	31.9 - 46.9 (41.6)	40.3 - 308 (100)	21.6 - 144 (59.1)
Lead	27.1 - 120 (76.6)	66.3 - 275 (128)	77.4 - 106 (92.2)	30.5 - 436 (153)	26.8 - 589 (137)
Mercury	0.06 - 0.31 (0.20)	0.16 - 0.30 (0.21)	0.16 - 0.20 (0.19)	0.05 - 0.29 (0.16)	0.04 - 0.58 (0.24)
Nickel	14.1 - 26.3 (20.5)	20.9 - 23.2 (22.4)	23.7 - 30.5 (28.2)	14.3 - 24.6 (20.2)	11.5 - 32.4 (23.2)
Selenium	1.7 - 2.6 (2.3)	2.2 - 2.5 (2.3)	1.6 - 2.0 (1.8)	0.48 - 1.4 (0.84)	0.48 - 2.2 (1.5)
Silver	0.10 - 0.41 (0.30)	0.19 - 0.25 (0.22)	0.22 - 0.38 (0.30)	0.07 - 0.33 (0.16)	0.03 - 0.25 (0.17)
Thallium	0.22 - 0.29 (0.26)	0.26 - 0.28 (0.27)	0.29 - 0.34 (0.32)	0.15 - 0.29 (0.21)	0.08 - 0.28 (0.24)
Tin	1.7 - 6.3 (3.7)	1.6 - 26.0 (6.2)	2.4 - 2.9 (2.7)	1.3 - 2.9 (2.3)	1.6 - 16.0 (4.3)
Trivalent Chromium	14.0 - 29.2 (22.1)	21.8 - 38.5 (26.5)	23.8 - 34.2 (30.7)	14.0 - 49.5 (26.7)	11.5 - 35.5 (23.0)
Zinc	56.6 - 192 (140)	99.1 - 192 (133.9)	131 - 194 (172)	130 - 284 (184)	72.6 - 577 (209)
Analyte	**DMMU 6 NN**	**DMMU 7 NN**	**DMMU 8 NN**	**DMMU 9 NN**	**DMMU 10 NN**
Aluminum	8,240 - 11,300 (9,825)	6,550 - 10,500 (8,536)	15,000 - 16,200 (15,500)	8,850 - 12,300	8,020
Antimony	0.06 - 0.11 (0.09)	0.09 - 0.13 (0.11)	0.10 - 0.14 (0.11)	0.04 - 0.07	0.09
Arsenic	4.7 - 8.2 (6.4)	3.9 - 6.4 (5.5)	6.6 - 8.1 (7.5)	6.2 - 7.5	5.7
Barium	160 - 324 (207)	151 - 189 (173)	223 - 1,070 (767)	162 - 636	158
Beryllium	0.59 - 1.1 (0.80)	0.53 - 0.93 (0.74)	0.87 - 0.93 (0.90)	0.69 - 0.84	0.75
Cadmium	0.42 - 0.64 (0.50)	0.38 - 0.61 (0.51)	0.71 - 0.95 (0.87)	0.43 - 0.72	0.73
Analyte	**DMMU 6 NN**	**DMMU 7 NN**	**DMMU 8 NN**	**DMMU 9 NN**	**DMMU 10 NN**
Calcium	8,580 - 14,600 (10,953)	10,100 - 161,000 (44,660)	4,650 - 8,770 (5,968)	7.740 - 13,200	7,680
Chromium	12.5 - 16.9 (14.4)	11.2 - 19.5 (14.5)	22.2 - 32.9 (26.4)	15.8 - 23.5	19.1
Copper	19.5 - 32.9 (24.2)	13.5 - 25.8 (21.6)	28.3 - 37.4 (33.3)	21.8 - 31.7	20.3
Lead	15.6 - 46.9 (28.1)	15.9 - 80.2 (35.8)	59.0 - 102 (74.0)	26.1 - 54.0	24.3
Mercury	0.05 - 0.19 (0.09)	0.05 - 0.12 (0.09)	0.13 - 0.35 (0.21)	0.05 - 0.14	0.09
Nickel	18.3 - 26.0 (22.1)	15.4 - 24.5 (21.5)	22.7 - 25.2 (24.1)	22.9 - 25.5	24.0
Selenium	0.84 - 1.4 (1.1)	BDL - 0.84	2.0 - 2.3 (2.2)	1.1 - 1.2	0.94
Silver	0.09 - 0.10 (0.09)	0.05 - 0.11 (0.08)	0.17 - 0.34 (0.26)	0.10 - 0.23	0.16
Thallium	0.21 - 0.27 (0.24)	0.21 - 0.25 (0.23)	0.27 - 0.30 (0.29)	0.29 - 0.30	0.25
Tin	0.50 - 1.2 (0.90)	0.50 - 2.1 (1.1)	1.6 - 3.1 (2.2)	0.80 - 1.9	1.4
Trivalent Chromium	12.5 - 16.9 (14.4)	11.2 - 19.5 (14.5)	22.2 -32.9 (26.4)	15.8 - 23.5	19.1
Zinc	53.8 - 100 (70.1)	41.3 - 107 (74.2)	81.5 - 143 (124)	78.2 - 142	77.0

Minimum, maximum, and average concentrations (in parentheses) are provided for DMMUs with multiple sampling sites.

Table 5. Detected metals in non-native fill (mg/kg).

Analyte	DMMU 3 F	DMMU 6 F	DMMU 7 F	DMMU 10 F
Aluminum	3,720 - 4,910 (4,360)	8,250 - 9,220 (8,735)	5,150 - 14,300 (8,905)	1,960 - 3,600
Antimony	0.04 - 0.08 (0.06)	0.08 - 0.10 (0.09)	0.14 - 0.64 (0.35)	0.03 - 0.04
Arsenic	2.6 - 3.6 (3.1)	5.6 - 6.2 (5.9)	5.4 - 6.8 (6.2)	1.5 - 3.7
Barium	62.8 - 87.8 (78.4)	153 - 245 (199)	359 - 1,050 (746)	38.2 - 99.4
Beryllium	0.26 - 0.41 (0.33)	0.60 - 0.74 (0.67)	0.42 - 0.93 (0.68)	0.20 - 0.35
Cadmium	0.19 - 0.29 (0.25)	0.48 - 0.56 (0.52)	0.38 - 1.4 (0.93)	0.16 - 0.27
Calcium	6,030 - 9,680 (8,280)	10,700 - 11,500 (11,100)	6,650 - 41,600 (18,188)	12,700 - 52600
Chromium	6.9 - 9.2 (8.0)	11.9 - 16.5 (14.2)	15.0 - 34.1 (23.9)	4.2 - 7.1
Copper	6.0 - 7.9 (7.0)	16.6 - 21.3 (19.0)	20.8 - 54.2 (37.8)	5.3 - 12.8
Lead	9.7 - 20.2 (16.4)	13.0 - 20.1 (16.6)	43.8 - 267 (206)	14.3 - 17.8
Mercury	0.02 - 0.03 (0.02)	0.05 - 0.05 (0.05)	0.05 - 0.22 (0.15)	0.02 - 0.03
Nickel	10.7 - 15.0 (12.9)	18.2 - 21.3 (19.8)	17.8 - 24.5 (21.4)	6.0 - 14.0
Selenium	0.86 - 0.99 (0.95)	0.78 - 1.3 (1.0)	0.74 - 1.0 (0.89)	0.24 - 0.76
Silver	0.04 - 0.09 (0.06)	0.09 - 0.09 (0.09)	0.04 - 0.23 (0.16)	0.03 - 0.06
Thallium	0.10 - 0.14 (0.12)	0.23 - 0.24 (0.24)	0.14 - 0.25 (0.20)	0.09 - 0.14
Tin	0.40 - 1.1 (0.63)	0.50 - 0.90 (0.70)	1.0 - 3.6 (2.5)	0.30 - 0.53
Trivalent Chromium	6.9 - 9.2 (8.0)	11.9 - 16.5 (14.2)	15.0 - 34.1 (23.9)	4.2 - 7.1
Zinc	24.3 - 37.7 (32.0)	46.3 - 75.6 (61.0)	209 - 519 (347)	19.7 - 47.2
Minimum, maximum, and average concentrations (in parentheses) are provided for DMMUs with multiple sampling sites.				

Table 6. Detected metals in native subsurface soil (mg/kg).

Analyte	DMMU 3 N	DMMU 4/5 N	DMMU 6 N	DMMU 7 N	DMMU 10 N
Aluminum	8,210 - 14,100 (10,630)	4,910 - 14,400 (9,969)	9,740 - 13,000 (10,740)	5,710 - 10,800 (8,189)	6,690 - 14,000 (9,323)
Antimony	0.03 - 0.09 (0.06)	0.02 - 0.08 (0.05)	0.06 - 0.11 (0.08)	0.06 - 0.12 (0.09)	0.06 - 0.08 (0.07)
Arsenic	5.2 - 7.5 (5.9)	4.2 - 9.5 (6.3)	5.4 - 6.3 (5.9)	4.8 - 7.2 (5.9)	4.1 - 6.3 (5.0)
Barium	81.8 - 179 (127)	27.7 - 362 (143)	141 - 229 (177)	148 - 191 (173)	123 - 178 (144)
Beryllium	0.57 - 1.0 (0.77)	0.32 - 1.1 (0.68)	0.68 - 1.1 (0.84)	0.60 - 1.0 (0.78)	0.53 - 0.95 (0.72)
Cadmium	0.28 - 0.47 (0.39)	0.08 - 0.65 (0.35)	0.42 - 0.69 (0.53)	0.43 - 0.64 (0.53)	0.30 - 0.68 (0.48)
Calcium	7,600 - 11,300 (9,945)	2,460 - 25,000 (12,549)	8,980 - 13,600 (11,363)	8,900 - 19,000 (12,625)	6,610 - 12,000 (9,837)
Chromium	11.5 - 20.1 (15.3)	8.9 - 22.3 (15.0)	13.6 - 18.0 (14.9)	10.4 - 15.9 (13.7)	11.7 - 26.0 (16.5)
Copper	14.3 - 21.1 (17.5)	4.8 - 33.0 (18.6)	19.6 - 27.2 (22.3)	21.0 - 28.7 (24.1)	12.2 - 21.9 (18.5)
Lead	12.3 - 21.1 (15.0)	7.4 - 35.2 (17.4)	15.1 - 19.6 (17.0)	14.0 - 34.8 (22.8)	11.4 - 24.3 (18.0)

Analyte	DMMU 3 N	DMMU 4/5 N	DMMU 6 N	DMMU 7 N	DMMU 10 N
Mercury	0.03 - 0.05 (0.04)	0.01 - 0.13 (0.05)	0.04 - 0.06 (0.05)	0.03 - 0.09 (0.05)	0.03 - 0.08 (0.05)
Nickel	16.6 - 23.7 (19.9)	6.1 - 32.1 (19.1)	19.4 - 27.9 (22.2)	20.0 - 24.4 (23.3)	18.5 - 24.9 (21.9)
Selenium	1.2 - 1.7 (1.5)	0.51 - 1.6 (0.96)	0.74 - 1.6 (1.3)	0.98 - 1.7 (1.2)	0.54 - 1.1 (0.75)
Silver	0.08 - 0.12 (0.09)	0.02 - 0.12 (0.08)	0.08 - 0.11 (0.10)	0.08 - 0.12 (0.10)	0.03 - 0.14 (0.09)
Thallium	0.19 - 0.25 (0.23)	0.11 - 0.36 (0.23)	0.24 - 0.29 (0.26)	0.23 - 0.28 (0.26)	0.19 - 0.28 (0.24)
Tin	0.50 - 2.0 (0.85)	0.20 - 0.80 (0.55)	0.40 - 0.90 (0.67)	0.60 - 0.80 (0.71)	0.50 - 1.4 (0.83)
Trivalent Chromium	11.5 - 20.1 (15.3)	8.9 - 22.3 (14.9)	13.6 - 18.0 (14.9)	10.4 - 15.9 (13.7)	11.7 - 26.0 (16.5)
Zinc	41.8 - 76.8 (53.6)	20.1 - 102 (61.0)	54.1 - 64.3 (58.1)	56.0 - 106 (74.9)	49.0 - 85.5 (67.3)
Minimum, maximum, and average concentrations (in parentheses) are provided for DMMUs with multiple sampling sites.					

Table 7. Detected metals in reference sediments and soil (mg/kg).

Analyte	Mississippi River (MR)	Mitigation Site (MT)	Saint Bernard (SB)	Bayou Laloutre (BL)
Aluminum	6,730	12,700	13,300	7,230
Antimony	0.04	0.75	0.09	0.03
Arsenic	3.3	12.4	6.6	5.8
Barium	106	191	80.2	132
Beryllium	0.46	1.0	1.0	0.61
Cadmium	0.45	1.7	0.46	0.31
Calcium	7,970	6,090	8,230	2,100
Chromium	13.3	42.3	19.2	10.8
Copper	10.9	84.5	19.4	13.2
Lead	14.1	264	14.7	9.9
Mercury	0.03	0.73	0.06	0.04
Nickel	16.6	28.2	23.0	16.2
Selenium	0.86	3.2	3.6	0.89
Silver	0.07	1.9	0.10	0.07
Thallium	0.14	0.28	0.22	0.15
Tin	0.82	12.9	0.83	0.34
Trivalent Chromium	13.3	22.1	19.2	10.8
Zinc	45.3	292	53.7	37.3

Table 8. Detected semi-volatiles in non-native sediments (µg/kg).

Analyte	DMMU 1 NN	DMMU 2 NN	DMMU 3 NN	DMMU 4 NN	DMMU 5 NN
1,2,4-Trichlorobenzene	BDL	BDL	BDL	BDL	BDL
1,2-dichlorobenzene	BDL	BDL	BDL	BDL	BDL
1,3-Dichlorobenzene	BDL	BDL	BDL	BDL	BDL
1,4-Dichlorobenzene	BDL - 26.0	BDL	BDL	BDL - 13.0	BDL - 14.0
2,4-Dimethylphenol	BDL	BDL - 16.0	BDL	BDL - 27.0	BDL
2-Chloronaphthalene	BDL	BDL - 66.0	BDL	BDL	BDL
2-chlorophenol	BDL	BDL - 81.0	BDL	BDL	BDL
2-Methylnapthalene	11.0 - 54.0 (27.2)	BDL - 130	8.8 - 30.0 (22.3)	20.0 - 270 (68.3)	BDL - 100
4-Methylphenol	BDL - 27.0	BDL - 11.0	BDL	BDL - 15.0	BDL - 32.0
Acenaphthene	53.0 - 190 (90.3)	32.0 - 710 (254)	99.0 - 430 (316)	80 - 1,400 (342)	11.0 - 730 (196)
Acenaphthylene	21.0 - 150 (72.7)	28.0 - 180 (76.0)	9.4 - 110 (63.5)	21.0 - 140 (55.5)	5.7 - 69.0 (40.5)
anthracene	41.0 - 300 (133)	52.0 - 760 (302)	40.0 - 500 (283)	140 - 6,300 (1,128)	18.0 - 930 (319)
Benzo(a)anthracene	88.0 - 790 (330)	120 - 640 (387)	62.0 - 1,100 (564)	320 - 4,300 (1,323)	49.0 - 470 (295)
benzo(a)pyrene	97.0 - 780 (345)	140 - 610 (358)	55.0 - 940 (495)	330 - 3,000 (1,031)	54.0 - 400 (276)
Benzo(b)fluoranthene	130 - 1,100 (460)	170 - 570 (413)	76.0 - 1,300 (679)	420 - 3,700 (1284)	74.0 - 550 (372)
Benzo(ghi)perylene	84.0 - 690 (279)	100 - 350 (213)	41.0 - 760 (390)	300 - 2,100 (754)	47.0 - 290 (197)
Benzo(k)fluoranthene	53 - 460 (178)	69.0 - 220 (155)	23.0 - 380 (201)	150 - 1,400 (479)	27.0 - 200 (138)
Benzoic acid	BDL	BDL	BDL	BDL - 41.0	BDL - 54.0
bis(2-Ethylhexyl) phthalate	220 - 2,700 (822)	110 - 290 (173)	13.0 - 290 (171)	250 - 1,700 (650)	130 - 3,400 (679)
Butyl benzyl phthalate	BDL - 95.0	BDL	BDL	BDL - 29.0	BDL - 36.0
Chrysene	120 - 1,100 (417)	140 - 650 (408)	61.0 - 1,200 (600)	370 - 4,400 (1,420)	55.0 - 520 (349)
Dibenz(a,h)anthracene	16.0 - 150 (64)	20.0 - 71.0 (50.8)	5.5 - 200 (102)	72.0 - 570 (208)	BDL - 77.0
Dibenzofuran	BDL - 45.0	BDL - 55.0	22.0 - 57.0 (42.0)	22.0 - 630 (142)	4.8 - 480 (90.1)
Diethyl Phthalate	BDL	BDL	BDL	BDL	BDL
Di-n-butyl phthalate	BDL	BDL	BDL	BDL - 50.0	BDL - 15.0
Di-n-octyl phthalate	BDL	BDL	BDL	BDL	BDL
Fluoranthene	260 - 2,200 (887)	270 - 1,800 (965)	210 - 3,600 (1,903)	990 - 13,000 (3,711)	96.0 - 1,900 (998)
Fluorene	36.0 - 110 (56.8)	24.0 - 480 (176)	61.0 - 310 (224)	69.0 - 2,100 (431)	6.8 - 990 (213)
Indeno(1,2,3-cd)pyrene	71.0 - 670 (272)	94.0 - 310 (209)	34.0 - 650 (338)	300 - 2,200 (771)	44.0 - 290 (202)
Napthalene	BDL - 50.0	BDL - 41.0	7.2 - 32.0 (21.4)	18.0 - 210 (61.6)	BDL - 50.0
Pentachlorophenol	BDL	BDL	BDL	BDL - 18.0	BDL
Phenathrene	110 - 520 (220)	120 - 1,900 (690)	170 - 1,400 (807)	230 - 9,200 (2,085)	30 - 2,500 (601)
Phenol	BDL - 25.0	BDL - 22.0	BDL	BDL - 6.1	BDL
Pyrene	270 - 1,900 (830)	350 - 1,700 (972)	180 - 2,600 (1,427)	700 - 8,000 (2,458)	120 - 1,600 (844)

Analyte	DMMU 6 NN	DMMU 7 NN	DMMU 8 NN	DMMU 9 NN	DMMU 10 NN
1,2,4-Trichlorobenzene	BDL	BDL	BDL	BDL	3.7
1,2-dichlorobenzene	BDL	BDL	BDL	BDL	2.5
1,3-Dichlorobenzene	BDL	BDL	BDL	BDL	4.1
1,4-Dichlorobenzene	BDL - 11.0	4.5 - 6.2 (5.5)	BDL	8.7 - 12.0	13.0
2,4-Dimethylphenol	BDL	BDL	BDL	BDL	4.1
2-Chloronaphthalene	BDL	BDL	BDL	BDL	BDL
2-chlorophenol	BDL	BDL	BDL	BDL	BDL
2-Methylnapthalene	BDL - 31.0	1.9 - 470 (96.6)	13.0 - 86.0 (41.0)	BDL - 25.0	21.0
4-Methylphenol	BDL - 7.0	2.6 - 42.0 (15.3)	BDL	BDL	6.5
Acenaphthene	BDL - 160	2.9 - 83.0 (22.1)	80.0 - 580 (288)	17.0 - 540	79.0
Acenaphthylene	BDL - 17.0	BDL - 48.0	29.0 - 50.0 (42.0)	8.2 - 71.0	12.0
anthracene	BDL - 64.0	10.0 - 58.0 (25.4)	60.0 - 230 (144)	18.0 - 460	44.0
Benzo(a)anthracene	BDL - 94.0	11.0 - 63.0 (33.0)	120 - 310 (220)	57.0 - 570	120
benzo(a)pyrene	2.9 - 85.0 (37.7)	11.0 - 66.0 (34.8)	93.0 - 250 (186)	67.0 - 390	68.0
Benzo(b)fluoranthene	3.8 - 120 (53.7)	16.0 - 69.0 (34.8)	120 - 350 (263)	110 - 620	110
Benzo(ghi)perylene	BDL - 59.0	15.0 - 62.0 (33.4)	63.0 - 150 (121)	44.0 - 220	56.0
Benzo(k)fluoranthene	1.4 - 52.0 (22.6)	BDL - 8.6	36.0 - 120 (89.8)	48.0 - 210	36.0
Benzoic acid	BDL - 29.0	22.0 - 32.0 (27.4)	BDL	BDL	31.0
bis(2-Ethylhexyl) phthalate	BDL - 80.0	30.0 - 180 (70.2)	41.0 - 150 (108)	39.0 - 99.0	190
Butyl benzyl phthalate	7.0 - 31.0 (14.5)	BDL - 220	BDL	BDL	10.0
Chrysene	BDL - 89.0	12.0 - 89.0 (38.2)	140 - 340 (258)	88.0 - 740	150
Dibenz(a,h)anthracene	BDL - 16.0	BDL - 29.0	13.0 - 45.0 (33.0)	BDL - 55.0	12.0
Dibenzofuran	BDL - 60.0	2.7 - 25.0 (8.9)	11.0 - 130 (49.0)	4.3 - 45.0	18.0
Diethyl Phthalate	BDL - 3.3	BDL	BDL	BDL	BDL
Di-n-butyl phthalate	BDL - 23.0	24.0 - 38.0 (27.4)	BDL	BDL	7.6
Di-n-octyl phthalate	BDL - 29.0	BDL - 8.1	BDL	BDL	BDL
Fluoranthene	3.1 - 290 (113)	22.0 - 94.0 (52.6)	470 - 1,400 (960)	210 - 2,800	380
Fluorene	BDL - 140	2.9 - 48.0 (14.7)	46.0 - 540 (227)	8.7 - 380	53.0
Indeno(1,2,3-cd)pyrene	BDL - 28.0	18.0 - 57.0 (32.4)	57.0 - 170 (129)	39.0 - 220	49.0
Napthalene	BDL - 36.0	2.8 - 35.0 (10.3)	10.0 - 19.0 (15.3)	BDL - 24.0	16.0
Pentachlorophenol	BDL	BDL	BDL	BDL	BDL
Phenathrene	2.2 - 310 (91.1)	9.7 - 220 (58.3)	190 - 850 (513)	29.0 - 1,200	320
Phenol	BDL - 9.8	BDL - 11.0	BDL	BDL	6.9
Pyrene	3.0 - 180 (76.8)	17.0 - 120 (57.0)	330 - 870 (645)	310 - 2,200	350

Minimum, maximum, and average concentrations (in parentheses) are provided for DMMUs with multiple sampling sites where an anlayte was detected.

BDL = Below Detection Limit.

Table 9. Detected semi-volatiles in non-native fill (µg/kg).

Analyte	DMMU 3 F	DMMU 6 F	DMMU 7 F	DMMU 10 F
1,4-Dichlorobenzene	BDL	BDL	8.1 - 15.0 (12.8)	8.9
2,4-Dimethylphenol	BDL	BDL	BDL - 16.0	BDL
2-Methylnapthalene	BDL	BDL	15.0 - 49.0 (32.0)	BDL - 3.5
4-Methylphenol	BDL	BDL	BDL - 20.0	BDL - 3.4
Acenaphthene	2.8 - 6.3 (4.7)	BDL	92.0 - 290 (171)	1.7 - 6.6
Acenaphthylene	BDL - 2.9	BDL	61.0 - 250 (130)	BDL - 4.5
anthracene	5.9 - 13.0 (8.5)	BDL - 4.1	160 - 420 (330)	BDL - 5.6
Benzo(a)anthracene	16.0 - 31.0 (23.3)	4.8 - 24.0 (14.4)	320 - 840 (575)	8.0 - 160
benzo(a)pyrene	16.0 - 29.0 (22.0)	7.2 - 30.0 (18.6)	370 - 1,200 (703)	7.4 - 180
Benzo(b)fluoranthene	23.0 - 38.0 (29.3)	8.1 - 38.0 (23.1)	500 - 1,600 (970)	10.0 - 230
Benzo(ghi)perylene	16.0 - 28.0 (21.3)	BDL - 29.0	160 - 800 (475)	BDL - 150
Benzo(k)fluoranthene	8.2 - 12.0 (10.4)	2.9 - 12.0 (7.5)	BDL - 680	BDL - 87.0
Benzoic acid	BDL	BDL	44.0 - 73.0 (55.3)	4.9
bis(2-Ethylhexyl) phthalate	BDL - 9.8	10.0 - 22.0 (16.0)	88.0 - 1,100 (512)	22.0 - 23.0
Butyl benzyl phthalate	BDL	BDL - 12.0	BDL - 40.0	5.5 - 5.7
Chrysene	20.0 - 29.0 (23.7)	4.5 - 29.0 (16.8)	370 - 1,000 (705)	8.7 - 160
Dibenz(a,h)anthracene	2.4 - 7.0 (4.4)	BDL - 5.1	74.0 - 210 (133)	BDL - 34.0
Dibenzofuran	1.9 - 3.4 (2.6)	BDL	17.0 - 80.0 (51.0)	1.8 - 33.0
Di-n-butyl phthalate	BDL	BDL	BDL - 49.0	BDL
Di-n-octyl phthalate	BDL - 3.2	BDL	BDL	BDL - 3.9
Fluoranthene	54.0 - 63.0 (58.0)	6.7 - 47.0 (26.9)	860 - 3,600 (2,165)	11.0 - 170
Fluorene	3.6 - 7.1 (5.2)	BDL	58.0 - 210 (128)	BDL - 3.6
Indeno(1,2,3-cd)pyrene	13.0 - 23.0 (17.7)	21.0 - 53.0 (37.0)	180 - 810 (485)	BDL - 150
Napthalene	BDL - 2.4	BDL	16.0 - 66.0 (36.3)	2.1 - 4.1
N-Nitrosodiphenylamine	BDL	BDL	BDL - 540	BDL
Phenathrene	29.0 - 44.0 (35.0)	2.0 - 13.0 (7.5)	220 - 720 (565)	7.0 - 42.0
Phenol	BDL	BDL	BDL - 7.9	BDL - 2.4
Pyrene	35.0 - 49.0 (40.0)	6.2 - 52.0 (29.1)	910 - 3,300 (1,953)	14.0 - 190

Minimum, maximum, and average concentrations (in parentheses) are provided for DMMUs with multiple sampling sites where an anlayte was detected.

BDL = Below Detection Limit.

Table 10. Detected semi-volatiles in native subsurface soil (µg/kg).

Analyte	DMMU 3 N	DMMU 4/5 N	DMMU 6 N	DMMU 7 N	DMMU 10 N
1,2,4-Trichlorobenzene	BDL	BDL	BDL	BDL	BDL - 5.9
1,2-dichlorobenzene	BDL	BDL - 130	52.0 - 110 (84.0)	96.0 - 440 (157)	BDL
1,3-Dichlorobenzene	BDL	BDL	BDL	BDL	BDL - 2.0
1,4-Dichlorobenzene	BDL	BDL - 14.0	BDL - 7.9	5.1 - 19.0 (10.4)	8.0 - 14.0 (10.2)
2,4-Dimethylphenol	BDL	BDL	BDL - 2.8	BDL - 1.9	BDL - 4.4
2,6-Dinitrotoluene	BDL	BDL	BDL	BDL - 14.0	BDL
2-chlorophenol	BDL	BDL - 50.0	7.3 - 110 (66.2)	12.0 - 300 (95.9)	BDL
2-Methylnapthalene	BDL	BDL - 7.4	BDL - 110	BDL - 390	BDL - 29.0
4-Methylphenol	BDL	BDL - 5.9	BDL - 15.0	BDL - 11.0	5.0 - 14.0 (8.3)
Acenaphthene	BDL - 4.4	BDL - 23.0	BDL - 190	1.7 - 45.0 (12.0)	2.2 - 400 (134.9)
Acenaphthylene	BDL	BDL - 4.6	BDL - 4.1	BDL - 5.8	BDL - 14.0
anthracene	BDL - 3.1	BDL - 220	BDL - 30.0	BDL - 22.0	BDL - 70.0
Benzo(a)anthracene	BDL - 7.3	BDL - 62.0	BDL - 19.0	BDL - 40.0	BDL - 99.0
benzo(a)pyrene	BDL - 7.8	BDL - 60.0	BDL - 10.0	BDL - 44.0	BDL - 51.0
Benzo(b)fluoranthene	BDL - 10.0	BDL - 74.0	BDL - 28.0	3.5 - 38.0 (16.6)	7.4 - 76.0 (31.5)
Benzo(ghi)perylene	BDL - 2.2	BDL - 46.0	BDL - 20.0	BDL - 43.0	BDL - 50.0
Benzo(k)fluoranthene	BDL - 3.2	BDL - 28.0	BDL - 9.4	BDL - 12.0	BDL - 26.0
Benzoic acid	BDL	BDL - 21.0	BDL - 32.0	7.1 - 41.0 (21.6)	6.0 - 18.0 (12.3)
bis(2-Ethylhexyl) phthalate	BDL - 9.6	BDL - 66.0	BDL - 64.0	16.0 - 75.0 (30.7)	11.0 - 76.0 (34.0)
Butyl benzyl phthalate	BDL - 17.0	BDL - 13.0	BDL - 150	BDL - 150	BDL - 12.0
Chrysene	BDL - 4.5	BDL - 72.0	BDL - 22.0	BDL - 63.0	6.0 - 100 (37.4)
Dibenz(a,h)anthracene	BDL	BDL - 15.0	BDL	BDL	BDL - 12.0
Dibenzofuran	BDL	BDL - 18.0	BDL - 110	2.3 - 7.3 (3.7)	2.4 - 28.0 (11.0)
Diethyl Phthalate	BDL	BDL	BDL - 3.3	BDL	BDL - 3.0
Di-n-butyl phthalate	BDL	BDL - 12.0	BDL - 28.0	7.0 - 29.0 (15.7)	5.4 - 6.3 (6.0)
Di-n-octyl phthalate	BDL - 2.6	BDL	BDL - 40.0	BDL - 19.0	BDL - 4.6
Fluoranthene	3.5 - 20.0 (9.6)	BDL - 170	BDL - 120	BDL - 110	7.8 - 850 (289)
Fluorene	BDL - 2.7	BDL - 60.0	BDL - 140	BDL - 35.0	2.3 - 240 (81.5)
Indeno(1,2,3-cd)pyrene	BDL - 3.8	BDL - 50.0	BDL - 11.0	BDL - 26.0	BDL - 41.0
Isophorone	BDL	BDL - 11.0	BDL	BDL - 7.2	BDL
Napthalene	BDL	BDL - 6.1	BDL - 150	BDL - 32.0	1.7 - 28.0 (10.7)
Phenathrene	2.2 - 8.3 (4.9)	8.5 - 130 (39.4)	BDL - 290	5.1 - 130 (31.0)	7.7 - 1,500 (506)
Phenol	BDL	BDL - 4.7	BDL - 5.7	BDL - 7.9	2.4 - 7.2 (4.1)
Pyrene	2.7 - 15.0 (7.3)	BDL - 120	BDL - 67.0	BDL - 120	9.0 - 550 (190)

Minimum, maximum, and average concentrations (in parentheses) are provided for DMMUs with multiple sampling sites where an anlayte was detected.

BDL = Below Detection Limit.

Table 11. Detected semi-volatiles in reference sediments and soil (µg/kg).

Analyte	Mississippi River (MR)	Mitigation Site (MT)	Saint Bernard (SB)	Bayou Laloutre (BL)
1,2-dichlorobenzene	60.0	170	BDL	BDL
2-chlorophenol	42.0	1,300	110	12.0
2-Methylnapthalene	2.40	27.00	BDL	BDL
Acenaphthene	1.9	BDL	BDL	BDL
Acenaphthylene	BDL	110	BDL	BDL
anthracene	2.8	91.0	BDL	BDL
Benzo(a)anthracene	7.4	180	BDL	BDL
benzo(a)pyrene	8.9	210	BDL	BDL
Benzo(b)fluoranthene	BDL	320	BDL	BDL
Benzo(ghi)perylene	4.60	280	BDL	BDL
Benzo(k)fluoranthene	BDL	110	BDL	BDL
bis(2-Ethylhexyl) phthalate	9.6	170	15.0	BDL
Butyl benzyl phthalate	BDL	350	BDL	BDL
Chrysene	9.2	220	BDL	BDL
Dibenz(a,h)anthracene	BDL	57.0	BDL	BDL
Fluoranthene	16.0	410	BDL	BDL
Fluorene	2.0	BDL	BDL	BDL
Indeno(1,2,3-cd)pyrene	5.9	200	BDL	BDL
Napthalene	2.20	BDL	BDL	BDL
Phenathrene	8.7	130	BDL	BDL
Pyrene	9.5	280	BDL	BDL
BDL = Below Detection Limit.				

Table 12. Detected pesticides, PCBs, and TPH in non-native sediment (µg/kg) unless otherwise noted.

Analyte	DMMU 1 NN	DMMU 2 NN	DMMU 3 NN	DMMU 4 NN	DMMU 5 NN
Aldrin	BDL - 14.0	BDL - 10.0	BDL - 0.39	BDL - 10.0	BDL - 13.0
alpha-BHC	BDL	BDL - 4.2	BDL	BDL	BDL - 0.66
alpha-chlordane	BDL - 17.0	BDL	BDL	BDL - 36.0	BDL
beta-BHC	BDL - 27.0	BDL - 23.0	BDL	BDL	BDL
DDD	5.3 - 36.0 (19.5)	8.2 - 27.0 (16.4)	13.0 - 29.0 (22.0)	BDL - 17.0	3.2 - 66.0 (17.8)
DDE	1.6 - 14.0 (6.5)	2.3 - 7.1 (4.4)	5.0 - 9.4 (7.6)	BDL - 8.2	BDL - 15.0
delta-BHC	BDL - 4.4	BDL	BDL	BDL - 4.2	BDL - 6.1
Dieldrin	BDL	BDL	BDL	BDL - 9.5	BDL - 2.4
endosulfan I	BDL	BDL - 1.2	BDL	BDL	BDL
Endosulfan II	BDL - 22.0	BDL	BDL	BDL	BDL
Endosulfan Sulfate	BDL - 16.0	BDL - 7.0	BDL - 5.1	BDL - 5.8	BDL - 6.5
Endrin aldehyde	BDL	BDL	BDL	BDL	BDL

gamma-chlordane	3.0 - 25.0 (9.9)	2.5 - 7.9 (4.7)	3.2 - 6.5 (4.6)	BDL - 260	BDL - 8.6
Heptachlor	BDL - 7.5	BDL - 0.85	BDL	BDL	BDL
Heptachlor epoxide	BDL - 9.2	BDL	BDL	BDL - 15.0	BDL - 5.4
Lindane	0.59 - 5.1 (2.5)	BDL - 2.5	BDL - 9.5	BDL - 7.6	BDL - 4.4
Methoxychlor	6.9 - 41.0 (21.2)	10.0 - 20.0 (14.8)	BDL - 16.0	BDL	BDL - 4.5
PCB-1016	BDL	BDL	BDL	BDL - 29.0	BDL
PCB-1248	28.0 - 200 (98)	24.0 - 93.0 (60.5)	48.0 - 87.0	BDL - 150	BDL - 260
PCB-1254	BDL - 250	39.0 - 140 (92.5)	71.0 - 100 (86.3)	BDL - 180	BDL - 260
PCB-1260	BDL - 130	BDL - 27.0	BDL	BDL - 150	BDL - 180
Total PCB	49.0 - 450 (198)	91.0 - 230 (159)	120 - 190 (150)	BDL - 420	BDL - 710
TPH-Diesel* (mg/kg)	22.0 - 88.0 (50.5)	15.0 - 270 (118)	370 - 570 (477)	58.0 - 2,100 (709)	230 - 1,000 (476)
TPH-Gasoline	54.0 - 150 (102)	89 - 59,000 (10,004)	180 - 260 (217)	54.0 - 2,600 (652)	48.0 - 1,200 (291)

Analyte	DMMU 6 NN	DMMU 7 NN	DMMU 8 NN	DMMU 9 NN	DMMU 10 NN
Aldrin	BDL - 3.0	2.0 - 11.0 (6.6)	BDL - 9.2	BDL	6.1
alpha-BHC	BDL	BDL	BDL - 3.9	BDL	BDL
alpha-chlordane	BDL - 3.1	BDL	BDL	BDL	BDL
beta-BHC	BDL	BDL	BDL - 10.0	BDL	BDL
DDD	BDL - 2.8	BDL - 5.4	8.3 - 16.0 (13.3)	BDL - 1.6	3.4
DDE	BDL - 0.6	BDL - 1.3	2.8 - 4.3 (3.7)	BDL - 0.60	3.1
delta-BHC	0.39 - 3.6 (1.8)	0.92 - 2.7 (1.9)	BDL	BDL	1.6
Dieldrin	BDL - 1.5	BDL	BDL	BDL	1.9
endosulfan I	BDL	BDL	BDL	BDL	BDL
Endosulfan II	BDL - 2.5	BDL - 5.6	BDL	BDL	1.7
Endosulfan Sulfate	BDL - 4.0	BDL - 4.4	BDL - 4.3	BDL	BDL
Endrin aldehyde	BDL	BDL - 2.7	BDL	BDL	BDL
gamma-chlordane	BDL - 0.83	BDL	1.7 - 4.3 (3.3)	BDL	BDL
Heptachlor	BDL - 0.56	BDL	BDL	BDL	BDL
Heptachlor epoxide	BDL - 1.1	BDL - 1.5	BDL	BDL	BDL
Lindane	BDL - 0.35	BDL - 1.0	BDL - 4.9	BDL	1.3
Methoxychlor	BDL	BDL	3.6 - 18.0 (11.9)	BDL	BDL
PCB-1016	BDL	BDL	BDL	BDL	BDL
PCB-1248	BDL - 20.0	BDL	11.0 - 52.0 (39.3)	BDL - 10.0	17.0
PCB-1254	BDL	BDL	BDL - 82.0	BDL - 14.0	BDL
PCB-1260	BDL - 83.0	BDL - 27.0	BDL - 45	BDL	22.0
Total PCB	BDL - 83.0	BDL - 27.0	22.0 - 130 (83.3)	BDL - 24.0	39.0
TPH-Diesel* (mg/kg)	49.0 - 170 (83.0)	55.0 - 690 (219)	18.0 - 120 (47.8)	45.0 - 550	17.0
TPH-Gasoline	41.0 - 85.0 (70.8)	80.0 - 260 (118)	120 - 1,800 (563)	55.0 - 140	83.0

Minimum, maximum, and average concentrations (in parentheses) are provided for DMMUs with multiple sampling sites where an anlayte was detected.

BDL = Below Detection Limit.

Table 13. Detected pesticides, PCBs, and TPH in non-native fill (µg/kg) unless otherwise noted.

Analyte	DMMU 3 F	DMMU 6 F	DMMU 7 F	DMMU 10 F
Aldrin	BDL - 0.39	BDL - 0.6	BDL - 34.0	1.7 - 2.0
alpha-chlordane	BDL	BDL	BDL - 56.0	BDL
beta-BHC	BDL - 6.5	BDL	BDL - 180	BDL
DDD	1.8 - 1.9 (1.9)	BDL - 20.0	BDL - 25.0	BDL - 0.40
DDE	1.3 - 5.7 (2.9)	BDL	BDL - 14.0	BDL
delta-BHC	1.0 - 3.7 (2.6)	0.67 - 2.3 (1.5)	BDL - 6.2	0.47 - 0.55
Dieldrin	BDL - 1.0	BDL	BDL - 32.0	BDL
Endosulfan II	BDL	BDL	BDL	0.74
Endosulfan Sulfate	BDL	BDL - 3.3	BDL - 17.0	BDL
Endrin	BDL	BDL	BDL - 10.0	BDL
Endrin aldehyde	BDL - 1.7	BDL	BDL - 4.1	BDL
gamma-chlordane	BDL - 0.93	BDL - 12.0	BDL - 27.0	BDL
Heptachlor epoxide	BDL	BDL - 11.0	BDL - 7.2	BDL
Lindane	BDL - 1.0	BDL	1.9 - 14.0 (6.6)	BDL - 0.28
PCB-1232	BDL	BDL	BDL - 2,300	BDL
PCB-1254	BDL	BDL - 430	BDL - 93.0	BDL
PCB-1260	BDL	BDL	BDL - 540	BDL
Total PCB	BDL	BDL - 430	BDL - 2,800	BDL
TPH-Diesel* (mg/kg)	44.0 - 100 (67.7)	18.0 - 160 (89.0)	170 - 1,300 (510)	19.0 - 110
TPH-Gasoline	42.0 - 46.0 (43.3)	48.0 - 100 (74.0)	82.0 - 1,000 (371)	BDL - 61.0

Minimum, maximum, and average concentrations (in parentheses) are provided for DMMUs with multiple sampling sites where an anlayte was detected.

BDL = Below Detection Limit.

Table 14. Detected pesticides, PCBs, and TPH in native subsurface soil (µg/kg) unless otherwise noted.

Analyte	DMMU 3 N	DMMU 4/5 N	DMMU 6 N	DMMU 7 N	DMMU 10 N
Aldrin	BDL - 4.0	0.88 - 21.0 (8.6)	BDL - 2.5	BDL - 7.2	3.8 - 10.0 (6.0)
alpha-chlordane	BDL	BDL	BDL	BDL - 1.7	BDL
beta-BHC	BDL - 1.1	BDL	BDL	BDL	BDL
DDD	BDL - 8.8	BDL - 2.6	BDL - 3.0	BDL - 8.1	0.50 - 1.9 (1.2)
DDE	BDL - 1.1	BDL - 0.20	BDL	BDL - 2.2	BDL - 1.4
delta-BHC	BDL - 7.2	BDL	BDL - 3.9	BDL - 1.8	BDL - 1.1

Analyte	DMMU 3 N	DMMU 4/5 N	DMMU 6 N	DMMU 7 N	DMMU 10 N
Dieldrin	BDL - 4.3	BDL - 0.56	BDL	BDL - 3.6	BDL
endosulfan I	BDL - 1.6	BDL - 57.0	BDL	BDL	BDL
Endosulfan II	BDL - 1.4	BDL - 2.0	BDL - 6.6	BDL - 15.0	0.71 - 2.1 (1.26)
Endosulfan Sulfate	BDL - 20.0	BDL - 0.34	BDL	BDL	BDL - 0.35
Endrin	BDL - 2.9	BDL	BDL	BDL - 1.2	BDL - 0.63
Endrin aldehyde	BDL - 9.4	BDL - 0.51	BDL	BDL	BDL
gamma-chlordane	BDL - 0.26	BDL - 2.0	BDL	BDL - 3.5	BDL
Heptachlor	BDL - 3.3	BDL	BDL	BDL	BDL
Heptachlor epoxide	BDL - 1.2	BDL - 1.4	BDL - 0.5	BDL	BDL
Lindane	BDL - 2.5	BDL - 2.0	BDL - 1.0	BDL - 0.79	0.34 - 0.68 (0.52)
PCB-1016	BDL	BDL - 6.3	BDL	BDL	BDL
PCB-1248	BDL	BDL - 27.0	BDL	BDL	BDL
PCB-1254	BDL	BDL - 50.0	BDL	BDL	BDL
PCB-1260	BDL - 1.3	BDL - 3.4	BDL	BDL - 6.6	BDL
Total PCB	BDL - 1.3	BDL - 50.0	BDL	BDL - 6.6	BDL
TPH-Diesel* (mg/kg)	14.0 - 190 (64.0)	BDL	BDL	BDL	5.0 - 39.0 (20.7)
TPH-Gasoline	44.0 - 95.0 (66.8)	BDL	BDL	BDL	BDL - 120

Minimum, maximum, and average concentrations (in parentheses) are provided for DMMUs with multiple sampling sites where an anlayte was detected.

BDL = Below Detection Limit.

Table 15. Detected pesticides, PCBs, and TPH in reference sediments and soil (µg/kg).

Analyte	Mississippi River (MR)	Mitigation Site (MT)	Saint Bernard (SB)	Bayou Laloutre (BL)
DDD	BDL	BDL	BDL	0.16
DDE	0.79	31.0	BDL	0.17
delta-BHC	BDL	BDL	11.00	3.40
Endrin	3.40	29.0	4.9	0.89
PCB-1248	BDL	240	BDL	BDL
PCB-1260	5.1	130	BDL	BDL
Total PCB	5.1	370	BDL	BDL

BDL = Below Detection Limit.

Table 16. Other detected analytes in non-native sediment (µg/kg) unless otherwise noted.

Analyte	DMMU 1 NN	DMMU 2 NN	DMMU 3 NN	DMMU 4 NN	DMMU 5 NN
Dibutyltin	BDL - 3.3	BDL	BDL	BDL - 11.0	BDL - 7.3
Tributyltin	BDL - 16.0	BDL	BDL - 3.8	BDL - 80.0	BDL - 6.6
Cyanide* (mg/kg)	BDL - 0.49	BDL - 3.6	BDL - 7.3	BDL - 4.7	BDL - 2.0
NH4-N* (mg/kg)	176 - 328 (248)	139 - 278 (221)	263 - 288 (278)	57.8 - 382 (184)	5.1 - 256 (119)
Dalapon	BDL	BDL	BDL	BDL - 25.0	BDL
Dichloroprop	BDL - 35.0	BDL	BDL - 76.0	BDL - 100	BDL
Dinoseb	BDL	BDL	BDL - 7.7	BDL - 4.7	BDL
2-Butanone	BDL	BDL	BDL	BDL - 2.5	BDL
Acetone	BDL - 20.0	BDL - 27.0	BDL	BDL - 19.0	BDL - 38.0
Benzene	BDL	BDL - 120	BDL	BDL	BDL
Bromodichloromethane	BDL	BDL	BDL	BDL - 4.2	BDL
Carbon disulfide	BDL	BDL	BDL	BDL - 3.3	BDL
Chlorobenzene	BDL	BDL - 27,000	BDL	BDL	BDL
Chloroform	BDL	BDL	BDL	BDL - 34.0	BDL
Ethylbenzene	BDL	BDL	BDL	BDL - 7.0	BDL
isopropylbenzene	BDL	BDL	BDL	BDL - 8.8	BDL
Methylene chloride	3.0 - 4.7 (3.9)	BDL - 5.0	5.0 - 6.1 (5.7)	2.5 - 6.9 (4.8)	3.3 - 11.0 (5.6)
n-Propylbenzene	BDL	BDL	BDL	BDL - 2.1	BDL
Analyte	**DMMU 6 NN**	**DMMU 7 NN**	**DMMU 8 NN**	**DMMU 9 NN**	**DMMU 10 NN**
Dibutyltin	BDL	BDL	BDL	BDL	2.3
Tributyltin	BDL	BDL	BDL - 3.0	BDL	BDL
Cyanide* (mg/kg)	BDL	BDL	BDL - 0.28	BDL - 22.5	BDL
NH4-N* (mg/kg)	36.4 - 84.2 (54.5)	74.2 - 120 (89.6)	16.1 - 282 (116)	130 - 250	237
Dalapon	BDL	BDL	BDL	BDL	BDL
Dichloroprop	BDL	BDL	BDL - 21.0	BDL - 130	BDL
Dinoseb	BDL	BDL	BDL	BDL	BDL
2-Butanone	BDL	BDL	BDL	BDL	BDL
Acetone	BDL - 29.0	7.7 - 23.0 (16.5)	BDL	BDL	12.0
Benzene	BDL	BDL	BDL	BDL	BDL
Bromodichloromethane	BDL	BDL	BDL	BDL	BDL
Carbon disulfide	BDL	BDL	BDL	BDL	BDL
Chlorobenzene	BDL	BDL	BDL	BDL	BDL
Chloroform	BDL	BDL	BDL	BDL	BDL
Ethylbenzene	BDL	BDL	BDL	BDL	BDL
isopropylbenzene	BDL	BDL	BDL	BDL	BDL
Methylene chloride	BDL - 67.0	BDL	2.9 - 3.5 (3.3)	2.6 - 4.0	BDL
n-Propylbenzene	BDL	BDL	BDL	BDL	BDL

Minimum, maximum, and average concentrations (in parentheses) are provided for DMMUs with multiple sampling sites where an anlayte was detected.

BDL = Below Detection Limit.

Table 17. Other detected analytes in non-native fill (µg/kg) unless otherwise noted.

Analyte	DMMU 3 F	DMMU 6 F	DMMU 7 F	DMMU 10 F
Dibutyltin	BDL	BDL	BDL - 67.0	BDL
Monobutyltin	BDL	BDL	BDL - 15.0	BDL
Tributyltin	BDL	BDL	BDL - 4.1	BDL
Cyanide* (mg/kg)	BDL - 0.21	BDL	BDL - 10.2	BDL
NH4-N* (mg/kg)	11.6 - 28.3 (18.2)	80.1 - 81.3 (80.7)	25.4 - 192 (107)	31.5 - 41.5
2,4-DB	BDL	BDL	BDL - 2,000	BDL
Dichloroprop	BDL	BDL	BDL - 25.0	BDL
Acetone	BDL	BDL - 38.0	BDL	BDL
isopropylbenzene	BDL	BDL	BDL - 5.5	BDL
Methylene chloride	2.0 - 3.6 (2.7)	BDL - 50.0	BDL - 4.4	BDL - 4.8
Minimum, maximum, and average concentrations (in parentheses) are provided for DMMUs with multiple sampling sites where an anlayte was detected. BDL = Below Detection Limit.				

Table 18. Other detected analytes in native subsurface soil (µg/kg) unless otherwise noted.

Analyte	DMMU 3 N	DMMU 4/5 N	DMMU 6 N	DMMU 7 N	DMMU 10 N
Cyanide* (mg/kg)	BDL - 0.32	BDL - 1.7	BDL	BDL	BDL - 0.24
NH4-N* (mg/kg)	60.5 - 200 (132)	1.5 - 227 (141)	86.7 - 185 (137)	33.5 - 211 (143)	119 - 183 (149)
2,4,5-T	BDL	BDL - 0.17	BDL	BDL	BDL
Dalapon	BDL	BDL - 36.0	BDL	BDL	BDL
Dicamba	BDL	BDL	BDL	BDL - 40.0	BDL
Dichloroprop	BDL	BDL	BDL	BDL - 120	BDL
MCPP	BDL	BDL - 2,600	BDL	BDL	BDL
Acetone	BDL - 46.0	BDL - 10.0	BDL - 38.0	BDL - 68.0	BDL - 30.0
Bromodichloromethane	BDL	BDL - 4.4	BDL	BDL	BDL
Chloroform	BDL	BDL - 33.0	BDL	BDL	BDL
isopropylbenzene	BDL	BDL - 11.0	BDL	BDL	BDL
Methylene chloride	2.4 - 5.4 (4.0)	BDL - 4.3	BDL - 1.7	BDL	BDL
Minimum, maximum, and average concentrations (in parentheses) are provided for DMMUs with multiple sampling sites where an anlayte was detected. BDL = Below Detection Limit.					

Table 19. Other detected analytes in reference sediments and soil (µg/kg) unless otherwise noted.

Analyte	Mississippi River (MR)	Mitigation Site (MT)	Saint Bernard (SB)	Bayou Laloutre (BL)
Cyanide* (mg/kg)	BDL	1.0	BDL	0.16
NH4-N* (mg/kg)	125	148	115	2.3
2,4,5-T	BDL	BDL	BDL	0.13
Dinoseb	BDL	BDL	BDL	0.91
Methylene chloride	4.2	15.0	7.2	2.9
BDL = Below Detection Limit.				

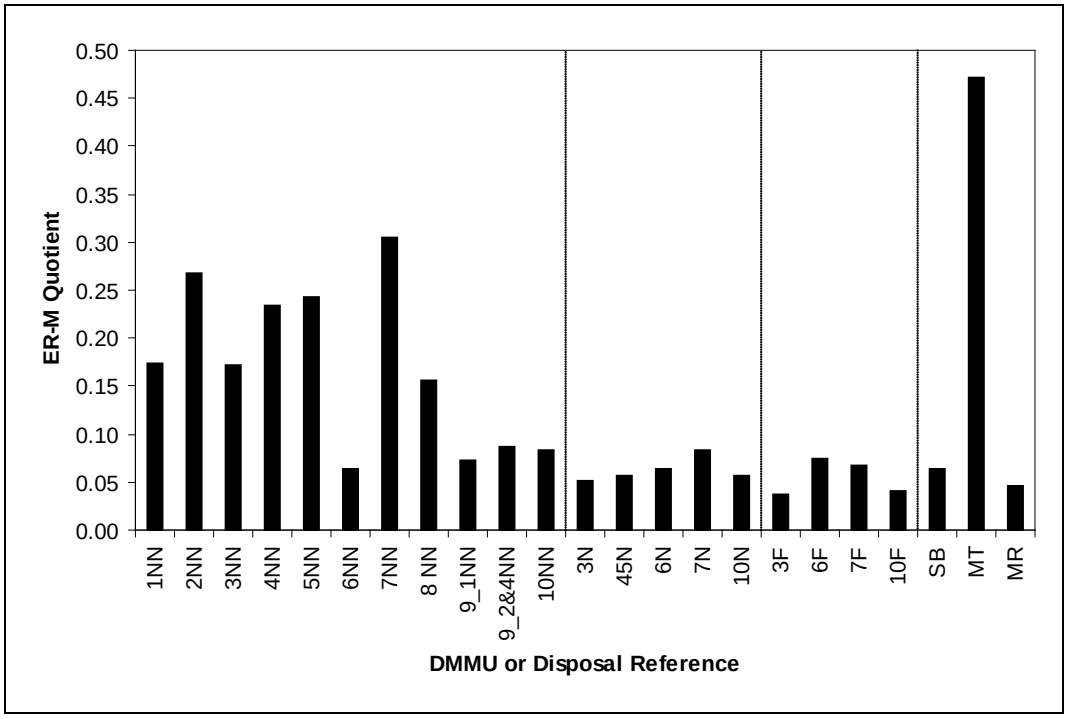

Figure 5. Metals ER-M_Q for DMMU sediment composites and disposal reference sediments.

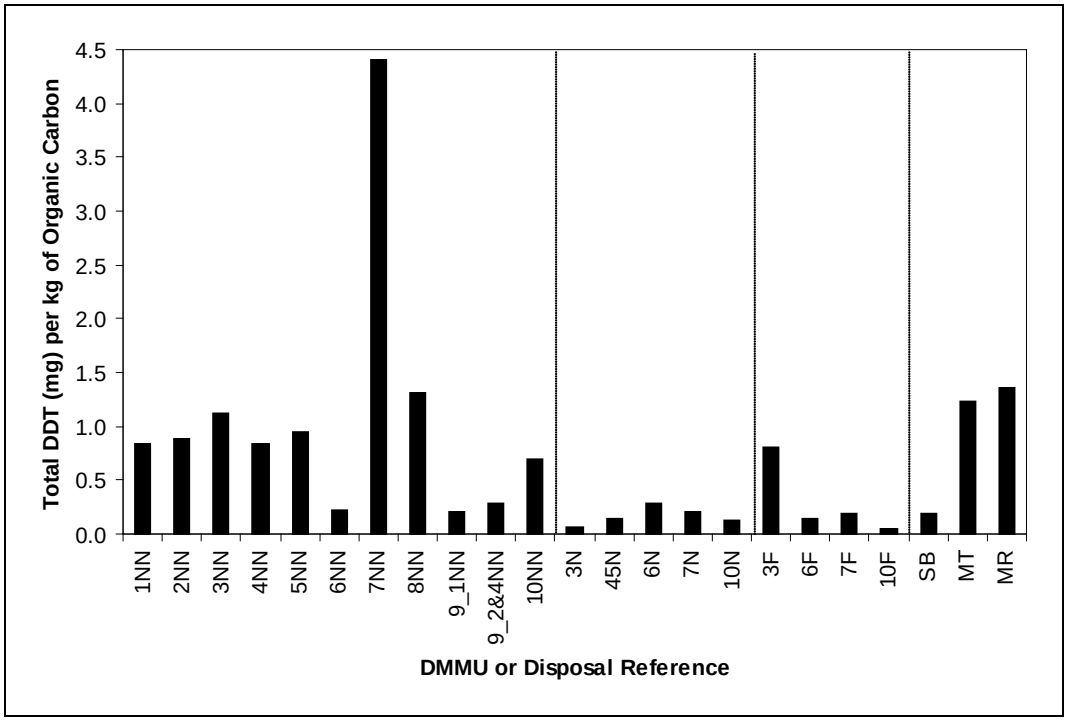

Figure 6. Total DDT normalized per kg of organic carbon for DMMU sediment composites and disposal reference sediments.

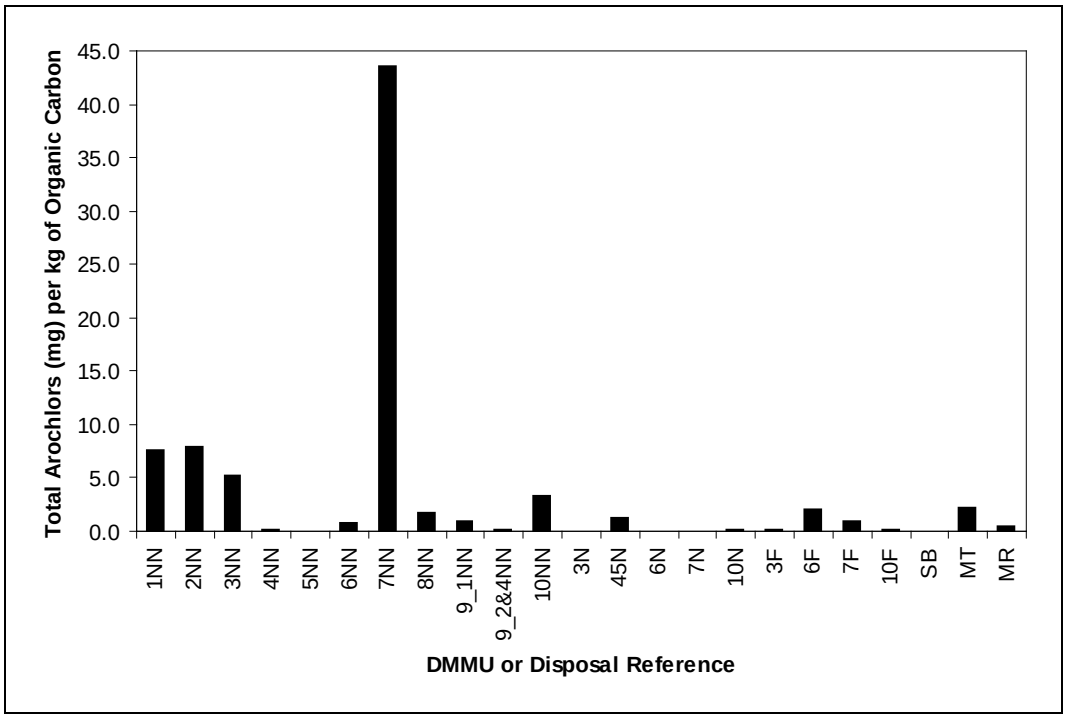

Figure 7. Total Aroclors normalized per kg of organic carbon for DMMU sediment composites and disposal reference sediments.

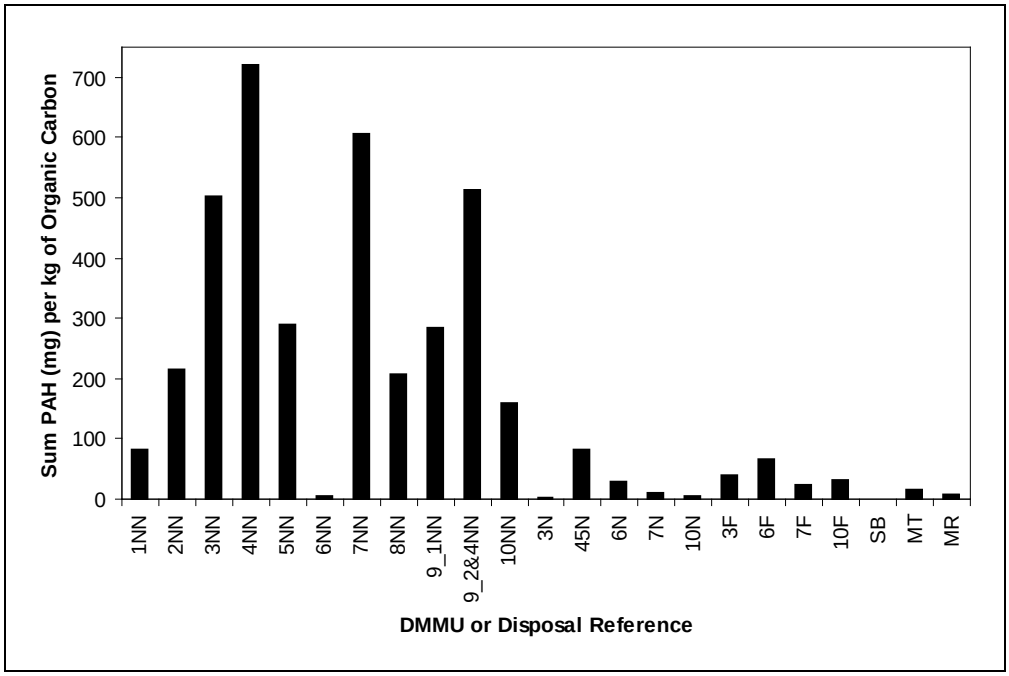

Figure 8. Sum PAH normalized per kg of organic carbon for DMMU sediment composites and disposal reference sediments. Sum PAH is defined as the sum of 2-methylnaphthalene, acenaphthene, acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(ghi)perylene, benzo(k)fluoranthene, chrysene, dibiz(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-cd)perylene, naphthalene, phenathrene, and pyrene. For any PAH reported as a non-detect, one half the reporting limit was included in the summation.

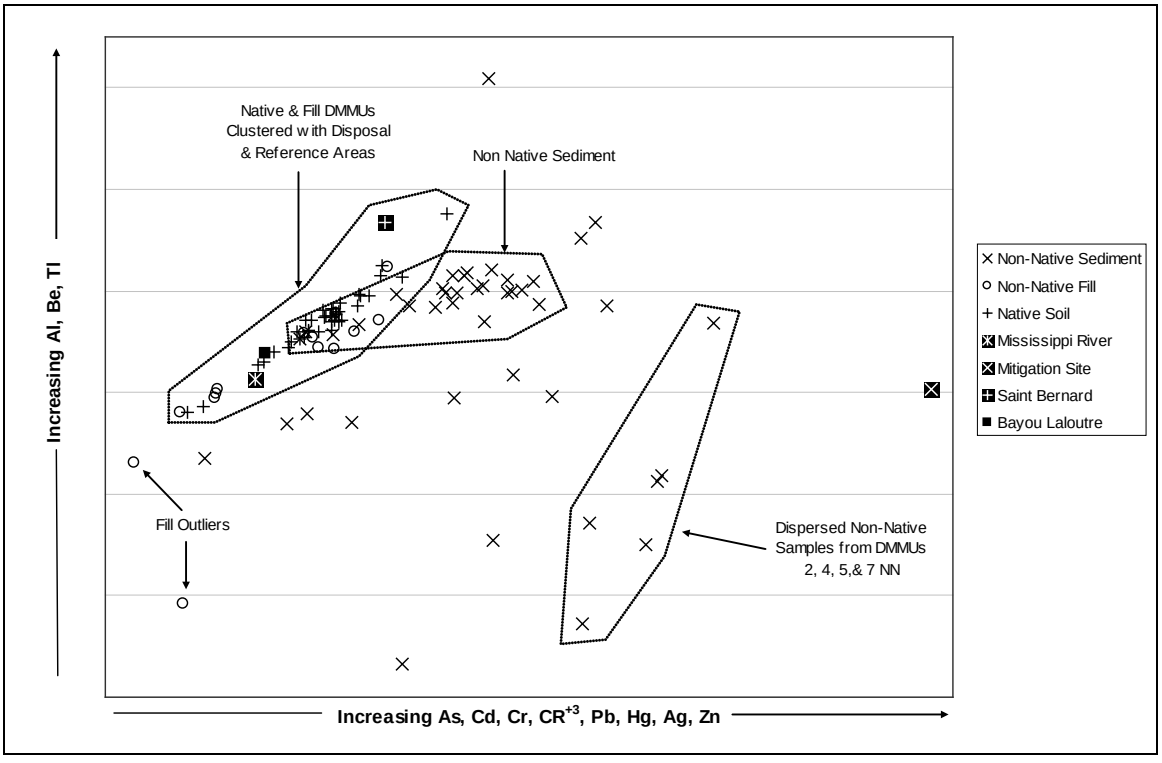

Figure 9. Sediment chemistry, metals MDS scores.

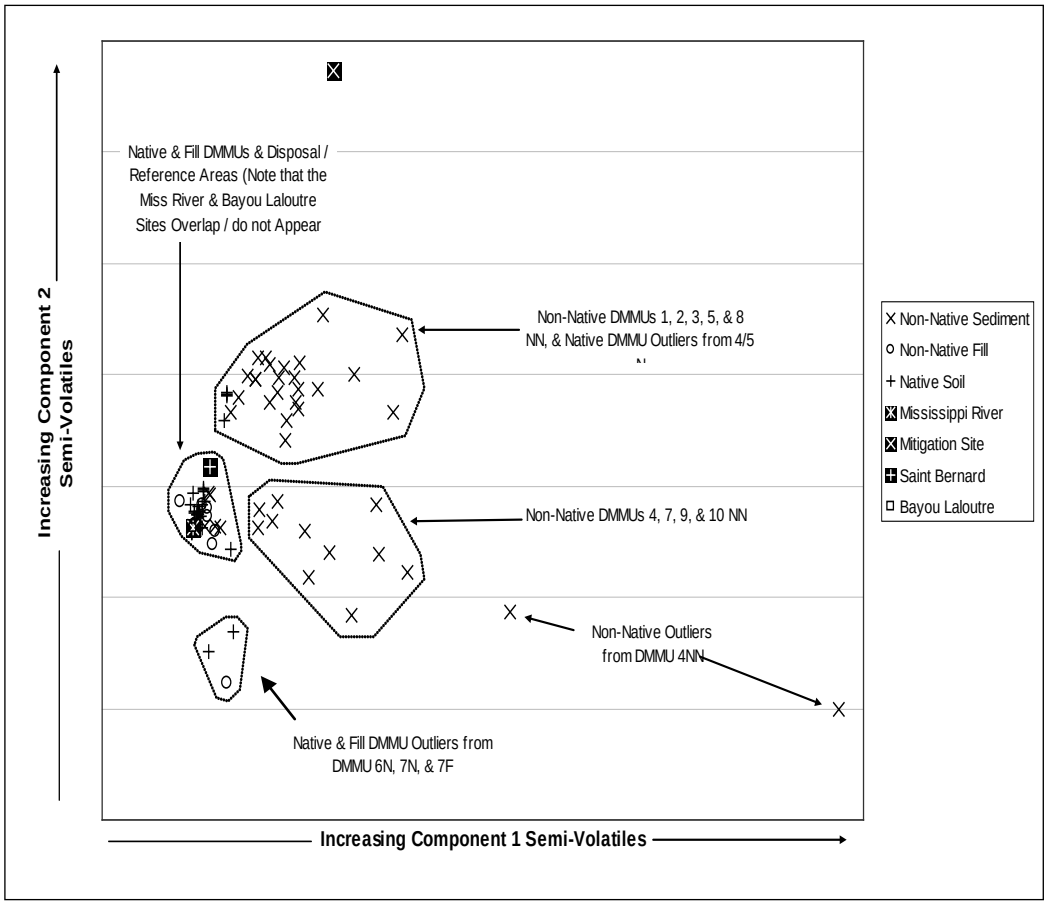

Figure 10. Sediment chemistry, semi-volatile scores.

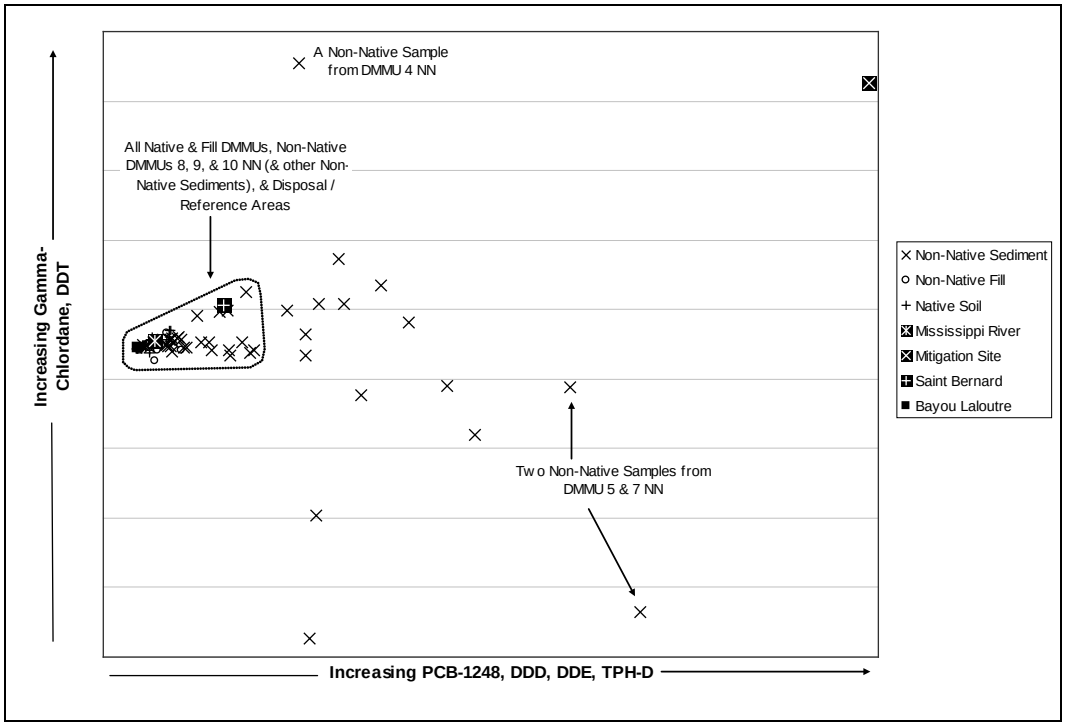

Figure 11. Sediment chemistry, pesticide, PAH, and PCB MDS scores.

Chemical trends

Average concentration of metals

Sediment quality benchmarks have been developed by National Oceanic & Atmospheric Administration to serve as a quick screening tool to assess sediment quality (Buchman 1999). These benchmarks include the *Effects Range Median* (ER-M) that represents the median of chemical concentrations observed or predicted to be associated with biological effects. ER-Ms for arsenic, cadmium, chromium, copper, lead, mercury, nickel, silver, and zinc were compared to values observed at each DMMU and disposal area. Observed concentrations were standardized by the ER-M for each metal and averaged across a given DMMU or disposal area to produce an ER-M Quotient (ER-M_Q). An ER-M_Q approaching or exceeding 1.0 may potentially be associated with adverse biological effects to benthic invertebrates, while values closer to zero are expected not to be associated with adverse effects. The resulting quotients are displayed in Figure 5. The highest ER-M_Q was observed at the mitigation site (0.47) and was influenced primarily by high concentrations of lead, mercury, silver, and zinc. There is considerable variation among non-native sediments, with ER-M_Q ranging from 0.07 to 0.30. ER-M_Qs were above 0.2 in non-native DMMUs 2, 4, 5, and 7 NN and were influenced primarily by high concentrations of lead and zinc. ER-M_Qs were less than 0.1 for the remaining non-native and disposal reference sediments, all non-native fill material, and all native subsurface soils.

Chlorinated pesticides, total Aroclors, and sum PAHs

Organochlorine pesticides (DDTs), Aroclors, and semi-volatile polycyclic aromatic hydrocarbons (PAH) are classes of organic compounds that may be associated with adverse ecological effects when present in sediment at total concentrations above 7, 180, and 40,000 ppb, respectively. Sediment total organic carbon (TOC) concentration has a major influence on the bioavailability and toxicity of hydrophobic organic contaminants in sediments and soils (Rand et al. 1995). For sediments with the same bulk concentration of a hydrophobic compound, the sediment with the highest TOC content is expected to contain the lowest bioavailable fraction and lowest porewater concentration of that compound. The sediment with the higher TOC content would be associated with the lowest bioaccumulation of that compound in exposed organisms. Therefore, presentation of TOC-normalized total concentrations of hydrophobic organic contaminants in

sediments provide metrics that can be used to estimate potential for bioaccumulation or potential to promote toxicity in benthic organisms exposed to these sediments. For each DMMU and reference area sediment, total concentrations of DDTs, Aroclors, and PAHs expressed as mg per kg of organic carbon are presented in Figures 6-8.

The TOC-normalized concentration of Total-DDT (sum concentration of DDD, p,p'DDE, and p,p'DDT) in non-native sediment from DMMU 7 was about 3.5 times higher than bioavailability in the Mississippi River and mitigation site disposal areas. TOC-normalized concentration for all other DMMUs was comparable or below that measured for the disposal sites. Non-native sediment DMMUs 6 and 9 NN, fill DMMUs 6, 7, and 10 F, and all native DMMUs had TOC-normalized concentration of Total-DDT similar to the Saint Bernard reference sediment.

As with Total-DDT, TOC-normalized concentration of Total Aroclor in non-native sediment from DMMU 7 NN far exceeded that in the Mississippi River and mitigation site. Concentrations for non-native DMMUs 1, 2, 3, and 10 NN were 1.5 to 16 times higher than concentrations for the disposal areas. Concentrations in non-native sediment DMMUs 4, 5, 6, 8, and 9 NN, and all fill and native DMMUs were similar to that observed at the disposal areas. Aroclor concentration in non-native sediment from DMMU 5 NN and from native DMMUs 3 and 7 N were comparable to that in the Saint Bernard reference sediment.

With the exception of DMMU 6 NN, TOC-normalized concentration of Total PAHs (sum concentration of acenaphthene, acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(ghi)perylene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, dibenzofuran, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, and pyrene) was 10 to 80 times higher at non-native DMMUs compared to the Mississippi River and mitigation site. Concentrations in fill and native DMMUs were generally 1.5 to 9 times higher than in the disposal areas. Total PAH concentration for native DMMUs 3, 7, and 10 N were within ranges measured for the disposal sites and approached those for the Saint Bernard reference area.

Multivariate analysis

Multivariate statistical procedures are useful in identifying variation between sample sites while considering several related random variables

simultaneously. Multidimensional scaling (MDS) is one such procedure that can be used to construct a two-dimensional figure depicting "distances" between sample sites based on scores for multiple variables. These distances are representative of similarities or dissimilarities between individual sample sites, with sites aligning closely on the figure having similar qualities compared to sites spaced further apart. The position of sample sites relative to the figure axes can be correlated with scores for each variable. The strength and direction of correlation provides a meaningful label for an axis, with the position of a site along an axis indicative of either a low or high score for a given variable (Manly 2000).

The MDS procedure was applied to the sediment chemistry data set to generate a table of distances between individual sampling sites, disposal areas, and reference areas based on observed concentrations of COC. Analytes that were detected or quantifiable below analytical detection limits in at least 20% of the sampling sites were selected for the analysis in an effort to minimize skewing of MDS distances by typically low and uniform values reported for non-detects. Additional standardization of COC was necessary prior to analysis to prevent analytes with larger ranges or higher overall concentrations from masking the influence of analytes typically present in lower and at less variable concentrations. The COC were grouped by contaminant class, and three separate analyses were performed to produce figures that display similarities in sites based on observed concentrations of (1) metals and cyanide, (2) semi-volatiles, and (3) PCBs, pesticides, and TPH. Figure axes were labeled based on correlation between distance coordinates for sampling sites and concentration of COC observed at the sites. For simplicity, DMMUs were grouped by sediment and soils type to focus discussion on overarching trends in the sediment chemistry data.

Figure 9 displays similarities between project sediments based on the concentration of metals and cyanide. The X-axis best describes increases in arsenic, cadmium, chromium, trivalent chromium, lead, mercury, silver, and zinc among project sediments, with correlations ranging from +0.7 to +0.9. Increases in the concentration of aluminum, beryllium, and thallium were moderately correlated (about +0.6) with the distribution of project sediments along the Y-axis. Non-native fill and native subsurface soils are clustered towards the low end of the X-axis with sediment collected from the Mississippi River disposal area and Bayou Laloutre and Saint Bernard reference areas. Two outlying fill sites set the low end of the X- and Y-axes.

In contrast, there is considerable variation in the distribution of non-native sediments, with some non-native sediments clustering with native and fill materials (DMMU 6 NN) or near disposal and reference areas (DMMUs 8, 9 , and 10 NN), and others dispersed towards the high end of the X-axis. Dispersed samples with higher concentration of metals include portions of non-native DMMUs 2, 4, 5, and 7 NN. Note that sediment collected from the mitigation site sets the high end of the X-axis.

Figure 10 displays similarities between project sediments based on the concentration of semi-volatiles. Variation in the semi-volatiles data can be split into two distinct components that are highly correlated (+0.72 to +0.97) with a single axis. The X-axis is best described by increases in acenaphthene, acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(ghi)perylene, benzo(k)-fluoranthene, chrysene, dibenz(a,h)anthracene, dibenzofuran, fluora-nthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, and pyrene. The Y-axis is best described by increases in 1,4-dichloro-benzene, 4-methylphenol, benzoic acid, di-n-butyl phthalate, di-n-octyl phthalate, and phenol. Non-native fill and native subsurface soils are tightly clustered towards the low end of both axes with sediment collected from the Mississippi River disposal area and Bayou Laloutre and Saint Bernard reference areas. A small cluster of outliers from two native and one fill DMMU set the low end of the scale on both axes. Similar to the metals data, there is considerable variation in the distribution of non-native sediments, but with two loosely associated clusters near the disposal and reference areas. The two non-native sediment clusters can be split along the Y-axis, with sediments from DMMUs 1, 2, 3, 5, and 8 NN having somewhat higher concentrations of semi-volatiles as compared to sediments collected from DMMUs 4, 7, 9, and 10 NN. A few outliers from non-native DMMU 4 NN set the high end of the x-axis, and sediment collected from the mitigation site sets the high end of the Y-axis.

Figure 11 displays similarities between project sediments based on the concentration of pesticides, TPH, and PCBs. The X-axis best describes increases in PCBs, DDD, DDE, DDT, and TPH-diesel, with moderate to strong correlations (+0.6 to +0.8). Increases in the concentration of gama-chlordane and DDT are moderately correlated (+0.6 and +0.5, respectively) with the distribution of project sediments along the Y-axis. Non-native fill, native subsurface soils, and non-native sediments from DMMUs 8, 9, and 10 NN form a tight cluster towards the low end of the X-axis along with

sediment collected from the Mississippi River disposal area and Bayou Laloutre and Saint Bernard reference areas. There is considerable variation in the distribution of the remaining non-native sediments, with some non-native sediments associating with the cluster described above and others dispersed towards the high end of both axes. Non-native sediment from DMMUs 5 and 7 NN set the high end of the X-axis, along with sediment collected from the mitigation site. A non-native sample from DMMU 4 NN sets the high end of the Y-axis, along with sediment from the mitigation site.

3 Water Column Toxicity Evaluation

Freshwater water column toxicity evaluation

In water column toxicity tests, a sensitive water column organism is exposed for 96 hr to serial dilutions (100, 50, and 10%) of dredged material elutriate, a site water treatment, and a performance control treatment of dechlorinated water, which is also used to dilute the elutriate to the 50 and 10% dilution treatments. When survival in the 100% dredged material elutriate treatment was at least 10% less than survival in the control, the results were evaluated statistically to determine if the survival in the elutriate treatment was significantly lower than the control.

A one-way Analysis of Variance (ANOVA; SPSS, Inc., Chicago, IL) was conducted to determine if statistically significant reductions relative to the control existed. Survival data were arc-sine square root transformed prior to analysis. In addition, when greater than 50% mortality occurred in at least one elutriate concentration, the lethal concentration calculated to induce 50% mortality ($LC_{50)}$ was determined by the Spearman-Karber or Probit method.

The fathead minnow (*Pimphales promelas*), a freshwater fish, was used to conduct 96-hr suspended particulate phase water column toxicity tests. Tests were conducted in three batches at elutriate concentrations of 0% (control water), 10%, 50%, and 100% (Weston Solutions 2008). Water quality parameters (i.e., temperature, pH, dissolved oxygen [DO], conductivity, and ammonia) were measured from each replicate chamber at experiment initiation and termination. Environmental chamber temperature was monitored and recorded daily. The endpoint assessed was survivorship, defined as complete lack of motility as determined by use of a blunt probe as necessary. Test acceptability criterion was greater than 90 percent mean control survival. Survival data are summarized in Table 20 and Figure 12. Mean survival in the control water for the three batches was high (92.0 % or higher, Table 21) and indicated that test conditions and health of the organisms were acceptable.

Survival in the 100% elutriate treatment was significantly lower than in the control water for non-native sediments of DMMUs 1, 6, 7, and 9 (DMMUs 1 NN, 6 NN, 7 NN, 9-1 NN), native subsurface soils of DMMUs 4/5, 6, 7, and

10 (DMMUs 4/5 N, 6 N, 7 N, and 10 N) and fill material from the bank of DMMUs 3 and 6 (DMMUs 3F and 6F) (Table 20). Among those, dilution to 50% concentration of elutriates from DMMUs 1 NN, 6 NN, 6 F, 9-1NN, 4/5 N, and 7 N resulted in survival not significantly lower than in the control, demonstrating that a two-fold dilution removed the acute toxicity promoted by their elutriates. Further dilution to 10% removed the acute toxicity of the elutriate of DMMU 7 NN and 10 N, but not for the elutriate of DMMU 3F. An exception to the trend of overall increase in survival with decreasing elutriate concentration was observed for the elutriate of DMMU 8NN, for which survival in the 10% dilution elutriate was significantly decreased while no statistical difference was determined for the 100% and 50% elutriates. Overall, no change in toxicity was observed; this was a departure from the expected trend of increasing elutriate dilution resulting in decreased mortality.

The reasons for the lack of decrease mortality trend for DMMU 8 NN are unknown.

Lowest observable effects concentrations (LOEC) were determined for treatments with at least one treatment significantly different from the control (Table 20). Median lethal concentrations (LC50), representing percent dilution associated with 50% mortality, were determined for elutriates from DMMUs 4/5N, 7NN, 7N, and 10N but could not determined for elutriate from DMMUs 1 NN, 3 F, 6 N, 6 F, 9-1 NN with at least one significantly different treatment due to insufficient mortality (Table 20).

Ammonia was a potential contaminant contributing to the significantly decreased survival in some samples based on concentrations measured at exposure initiation (Table 22). An ammonia toxicity reduction was conducted using zeolite (Hockett and Mount 1996, Burgess et al. 2003). Since zeolite may remove some metals, ethylenediamine tetraacetic acid (EDTA) was used to complex metals in a separate treatment in order to discriminate between metals and ammonia toxicity. EDTA should not alter ammonia concentrations. Separate aliquots of elutriate samples suspected of ammonia toxicity were treated with zeolite and EDTA. These separate treatments were run side by side with the untreated elutriate. It was concluded that ammonia may have contributed to the decreased toxicity in elutriates from DMMUs 7 NN, 4/5 N, and 9-1 NN. In addition, ammonia was unlikely to have contributed to toxicity in the elutriate of DMMU 6 N,

while inconclusive results were obtained for elutriates from DMMUs 1 NN and 2 NN (Weston Solutions 2008).

Table 20. *Pimephales promelas* 4-day freshwater suspended phase toxicity tests. Mean percent survival in exposure to IHNC dredged material elutriates at different dilutions, statistical comparison with mean survival in control water, and toxicity endpoints.

DMMU	Treatment (% elut.)	Percent Survival			LOEC (% elut.)	LC50 (% elut.)	Batch
		Mean	Std. Dev	Statistical Comparison with Reference			
1 NN	100	58	13	Different	100	ND	1
	50	98	4	Not different			
	10	98	4	Not different			
2 NN	100	78	16	Not different	ND	ND	1
	50	94	9	Not different			
	10	100	0	Not different			
3 NN	100	98	4	Not different	ND	ND	1
	50	92	8	Not different			
	10	96	5	Not different			
3 N	100	94	5	Not different	ND	ND	
	50	92	13	Not different			
	10	88	8	Not different			
3 F	100	50	20	Different	10	ND	1
	50	58	11	Different			
	10	50	19	Different			
4 NN	100	94	9	Not different	ND	ND	3
	50	94	5	Not different			
	10	100	0	Not different			
5 NN	100	92	8	Not different	ND	ND	3
	50	96	5	Not different			
	10	100	0	Not different			
4/5 N	100	2	4	Different	100	69	3
	50	94	5	Not different			
	10	100	0	Not different			
6 NN	100	86	5	Not different	ND	ND	2
	50	96	5	Not different			
	10	86	17	Not different			
6 N	100	70	20	**Different**	100	ND	2
	50	86	5	Not different			
	10	82	25	Not different			

DMMU	Treatment (% elut.)	Percent Survival			LOEC (% elut.)	LC50 (% elut.)	Batch
		Mean	Std. Dev	Statistical Comparison with Reference			
6 F	100	82	8	**Different**	100	ND	2
	50	82	19	Not different			
	10	82	16	Not different			
7 NN	100	14	11	**Different**	50	42	2
	50	46	22	**Different**			
	10	90	10	Not different			
7 N	100	18	20	**Different**	100	72	2
	50	82	11	Not different			
	10	88	13	Not different			
7 F	100	76	13	Not different	ND	ND	2
	50	96	5	Not different			
	10	100	0	Not different			
8 NN	100	86	13	Not different	10	ND	1
	50	98	4	Not different			
	10	53	17	**Different**			
9-1 NN	100	82	11	**Different**	100	ND	3
	50	98	4	Not different			
	10	98	4	Not different			
9 2,4-NN	100	94	5	Not different	ND	ND	3
	50	92	8	Not different			
	10	92	13	Not different			
10 NN	100	88	11	Not different	ND	ND	2
	50	82	8	Not different			
	10	94	5	Not different			
10 N	100	2	4	**Different**	50	26	2
	50	14	15	**Different**			
	10	98	4	Not different			
10 F	100	72	33	Not different	ND	ND	2
	50	92	13	Not different			
	10	90	17	Not different			

LOEC = lowest-observed effects concentration. LC50 = median effect concentration.
ND = not determined due to insufficient mortality. “elut” = elutriate.

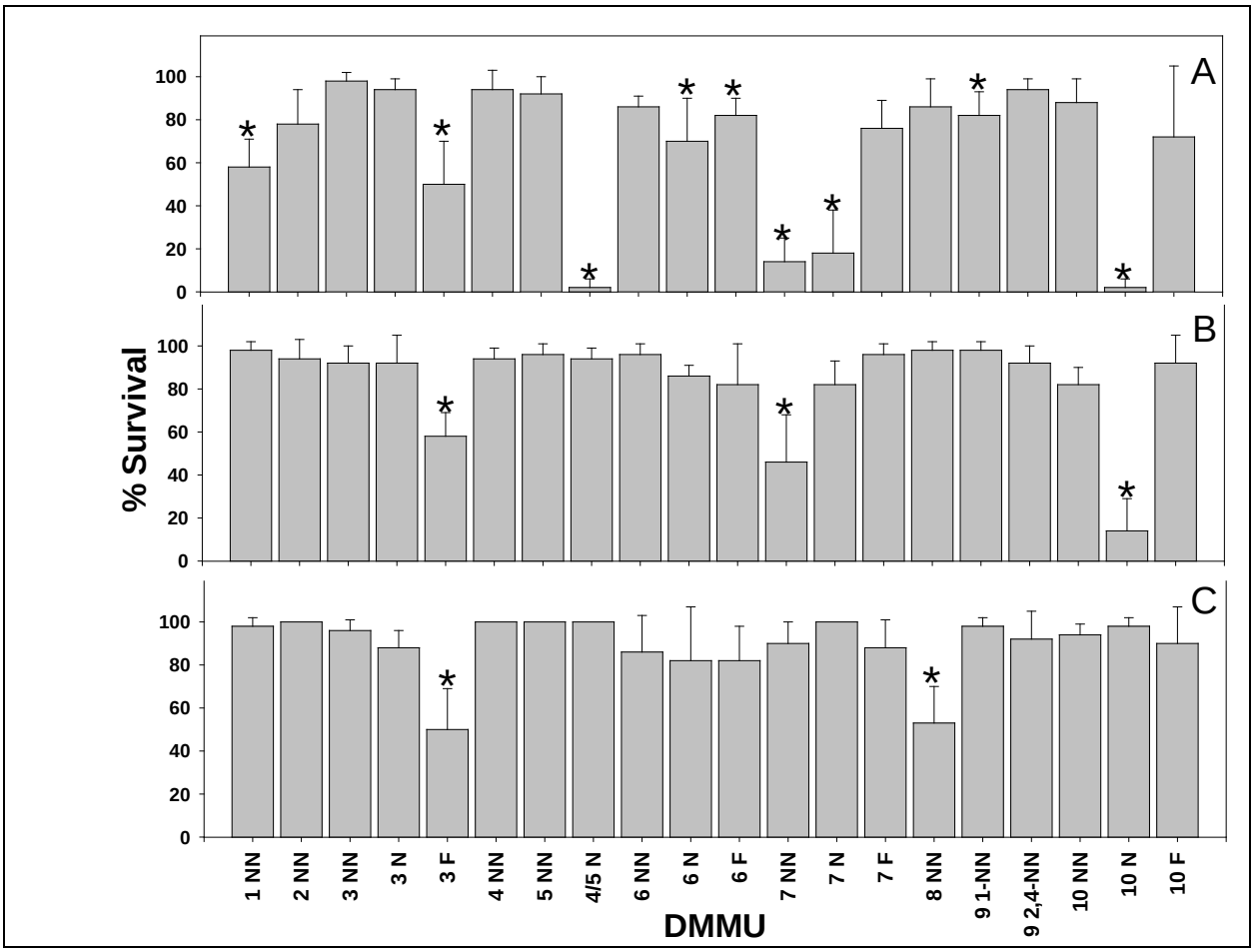

Figure 12. *Pimephales promelas* 4-day freshwater suspended phase toxicity tests. Mean percent survival in exposure to IHNC dredged material elutriates at different dilutions (* indicates statistically significant decreased survival).

Table 21. *Pimephales promelas* 4-day freshwater suspended phase toxicity tests. Mean percent survival in exposure to control water for exposure batches 1, 2, and 3.

	Percent Survival	
Batch	Mean	Std. Dev
1	92	4
2	96	5
3	98	4

Table 22. *Pimephales promelas* 4-day suspended phase freshwater toxicity tests. Ammonia concentration measured at exposure initiation and mean percent survival in undiluted elutriate and in zeolite- and EDTA-treated undiluted elutriate at exposure termination.

DMMU	Treatment	Day 0 Ammonia	Percent Survival		
		mg/L	Mean	Std. Dev	Statistical Comparison with Reference
1 NN	100%	5	58	13	Different
	100%-Zeolite	< 1	100	0	Not different
	100%-EDTA	4	0	0	Not different
2 NN	100%	5	78	16	Not different
	100%-Zeolite	< 1	100	0	Not different
	100%-EDTA	4	0	0	Different
6 N	100%	6	70	20	Not different
	100%-Zeolite	< 1	57	23	Different
	100%-EDTA	6	67	6	Different
7 NN	100%	5	14	11	Different
	100%-Zeolite	< 1	83	6	Different
	100%-EDTA	5	17	12	Different
4/5 N	100%	> 8	2	4	Different
	100%-Zeolite	<1	80	0	Different
	100%-EDTA	> 8	0	0	Different
9-1 NN	100%	5	82	11	Different
	100%-Zeolite	< 1	97	6	Not different
	100%-EDTA	4	87	6	Not different

Based on the results of the suspended particulate phase water column toxicity tests, dredged materials from DMMUs 2 NN, 3 NN, 3N, 4 NN, 5 NN, 6 NN, 7 F, 8 NN, 9-2,4 NN, 10NN, and 10 F are not predicted as acutely toxic to freshwater water column organisms.

Dredged materials from DMMUs 1 NN, 3 F, 4/5 N, 6 N, 6 F, 7 NN, 7 N, 9-1 NN, and 10 N are predicted as potentially acutely toxic to freshwater water column organisms. Those dredged materials were further analyzed for their potential to cause acute toxic impacts to water column organisms at the Mississippi River disposal site according to available dilution across an allowable mixing zone (Section 4).

Potential for dredged material disposal causing adverse impacts to water column organisms at the Mississippi River disposal site was further evalu-

ated by comparing potential for state or Federal water quality standards to be exceeded outside the mixing zone (Section 4).

Estuarine water column toxicity evaluation

Sheepshead minnow (*Cyprinodon variegatus*), an estuarine fish, was used to conduct 96-hr suspended particulate phase water column toxicity tests. Tests were conducted in three batches at elutriate concentrations of 0% (control water), 10%, 50%, and 100% (Weston Solutions 2008). Water quality parameters (i.e., temperature, pH, dissolved oxygen [DO], conductivity, and ammonia) were measured from each replicate chamber at experiment initiation and termination. Environmental chamber temperature was monitored and recorded daily. The endpoint assessed was survivorship, defined as complete lack of motility as determined by use of a blunt probe as necessary. Test acceptability criterion was greater than 90 percent mean control survival. Survival data are summarized in Table 23 and Figure 13. Mean survival in the control water for the three batches was high (98% or higher) and indicated that test conditions and health of the organisms were acceptable (Table 24). Mean survival was high (96% and higher) in all treatments for all elutriate samples evaluated.

A one-way Analysis of Variance (ANOVA; SPSS, Inc., Chicago, IL) was conducted to determine if statistically significant reductions relative to the control existed. Survival data were arc-sine square root transformed prior to analysis.

There was no significant difference in survival between elutriates derived from channel sediment and control water for all of the samples and elutriate concentrations. Because there were only minor (4% and lower) and non-significant differences in survival between elutriates derived from channel sediment and control water for all of the samples and elutriate concentrations, no LOEC or LC_{50} values could be generated for the samples evaluated.

Based on the results of the suspended particulate phase water column toxicity tests, dredged materials from all DMMUs are not predicted as acutely toxic to estuarine column organisms. Potential for dredged material disposal causing adverse impacts to water column organisms at the mitigation site was further evaluated by comparing potential for state or Federal water quality standards to be exceeded outside the mixing zone (Section 4).

Table 23. *Cyprinodon variegatus* estuarine 4-day suspended phase toxicity tests. Mean percent survival in exposure to IHNC dredged material elutriates at different dilutions and statistical comparison with mean survival in control water.

DMMU	Treatment (% elut.)	Percent Survival			LOEC (% elut.)	LC50 (% elut.)	Batch
		Mean	Std. Dev	Statistical Comparison with Reference			
1 NN	100	100	0	Different	ND	ND	1
	50	100	0	Not different			
	10	100	0	Not different			
2 NN	100	100	0	Not different	ND	ND	1
	50	100	0	Not different			
	10	100	0	Not different			
3 NN	100	100	0	Not different	ND	ND	1
	50	98	4	Not different			
	10	100	0	Not different			
3 N	100	100	0	Not different	ND	ND	1
	50	100	0	Not different			
	10	100	0	Not different			
3 F	100	100	0	Not different	ND	ND	1
	50	100	0	Not different			
	10	100	0	Not different			
4 NN	100	100	0	Not different	ND	ND	3
	50	100	0	Not different			
	10	100	0	Not different			
5 NN	100	100	0	Not different	ND	ND	3
	50	100	0	Not different			
	10	100	0	Not different			
4/5 N	100	98	4	Not different	ND	ND	3
	50	100	0	Not different			
	10	100	0	Not different			
6 NN	100	100	0	Not different	ND	ND	2
	50	100	0	Not different			
	10	100	0	Not different			
6 N	100	98	4	Not different	ND	ND	2
	50	100	0	Not different			
	10	100	0	Not different			
6 F	100	100	0	Not different	ND	ND	2
	50	98	4	Not different			

DMMU	Treatment (% elut.)	Percent Survival			LOEC (% elut.)	LC50 (% elut.)	Batch
		Mean	Std. Dev	Statistical Comparison with Reference			
	10	96	5	Not different			
7 NN	100	100	0	Not different	ND	ND	2
	50	100	0	Not different			
	10	100	0	Not different			
7 N	100	100	0	Not different	ND	ND	2
	50	100	0	Not different			
	10	100	0	Not different			
7 F	100	98	4	Not different	ND	ND	2
	50	96	5	Not different			
	10	100	0	Not different			
8 NN	100	100	0	Not different	ND	ND	1
	50	100	0	Not different			
	10	100	0	Not different			
9-1 NN	100	100	0	Not different	ND	ND	3
	50	100	0	Not different			
	10	100	0	Not different			
9 2,4-NN	100	96	5	Not different	ND	ND	3
	50	100	0	Not different			
	10	100	0	Not different			
10 NN	100	96	9	Not different	ND	ND	2
	50	100	0	Not different			
	10	100	0	Not different			
10 N	100	100	0	Not different	ND	ND	2
	50	100	0	Not different			
	10	100	0	Not different			
10 F	100	100	0	Not different	ND	ND	2
	10	100	0	Not different			
	100	100	0	Not different			

LOEC = lowest-observed effects concentration.

LC50 = median effect concentration.

ND = not determined due to insufficient mortality.

"elut" = elutriate.

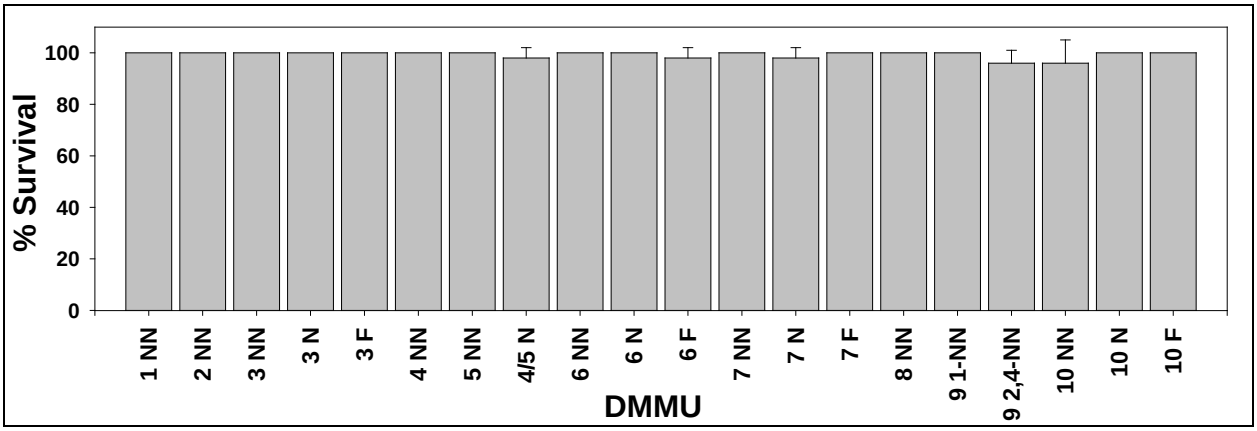

Figure 13. *Cyprinodon variegatus* estuarine 4-day suspended phase toxicity tests. Mean percent survival in exposure to IHNC dredged material elutriates at different dilutions.

Table 24. *Cyprinodon variegatus* estuarine 4-day solid phase toxicity tests. Mean percent survival in exposure to control water for exposure batches 1, 2, and 3.

	Percent Survival	
Batch	Mean	Std. Dev
1	100	0
2	100	0
3	98	4

4 Comparison of Standard and Modified Elutriate Results to Standards and Calculation of Mixing Zones

This section of the report addresses the interpretation of elutriate testing results for the various placement alternatives under consideration. Four placement alternatives are being considered:

- Open water disposal in the Mississippi River.
- Upland disposal in a CDF, with effluent discharge to the GIWW or Bayou Bienvenue.
- Beneficial use placement in the proposed mitigation site.
- Beneficial use placement as construction fill around the new lock.

The standard elutriate test is used to model impacts associated with open water disposal, while the modified elutriate test is used to model impacts associated with discharges from a CDF. These tests are discussed in that context in Sections 4.1 and 4.2, respectively. Both the standard and elutriate tests are potentially applicable for evaluation of impacts associated with placement of material at the mitigation site. The modified elutriate test more likely reflects the effects of aeration that would occur if the discharge takes place above the surface of the water, above newly placed material, or in shallow water depths. The standard elutriate test more likely reflects the water quality impacts of subsurface discharges at depth. At the present stage of planning, the degree of containment that will be employed has not been determined. Water depth is believed to be shallow throughout the mitigation site, but given the uncertainty regarding the disposal operation and the site in general, both standard and elutriate tests were considered in the context of potential placement in the mitigation site, discussed in the section titled “Mixing evaluation for placement of dredged material in the proposed mitigation site.” The dredging elutriate is used to predict effects on water quality during dredging, and the dredging elutriate test is discussed in that context in Appendix B.

Elutriate results are summarized in each of the following sections. These are followed by tables comparing elutriate concentrations to water quality

criteria or standards and listing the corresponding dilution requirements obtained through this comparison. The ability of the receiving water to achieve the necessary dilution in a mixing zone compliant with State of Louisiana water quality regulations is then evaluated, relevant or mitigating points discussed, and conclusions presented. There are a number of similarities between the sections and this may be confusing to the reader. The general organization of these sections is listed below to provide additional clarity. Relevant tables and figures are located at the end of each section.

- Potential water quality impacts associated with open water disposal of dredged material
    - Objectives
    - Data evaluation and dilution requirements
        - *MR site dilution requirements*
        - *Mitigation site dilution requirements*
    - Mixing
    - Discussion
    - Conclusions
- Potential water quality impacts associated with release of effluent from confined disposal facilities
    - Objectives
    - Data evaluation and dilution requirements
        - *GWW dilution requirements*
        - *Bayou Bienvenue dilution requirements*
    - Mixing
        - *GIWW mixing*
        - *Bayou Bienvenue mixing*
    - Conclusions

- Mixing evaluation for placement of dredged material in the proposed mitigation site
    - Objectives
    - Data evaluation and dilution requirements
        - *Material suitability*
        - *Dilution requirements*
    - Mitigation site mixing
    - Potential recoverable area
    - Conclusion

Potential water quality impacts associated with open water disposal of dredged material

Objectives

The standard elutriate (SE) test is described in USEPA/USACE (1998), Section 10.1.2.1 and is specified for the assessment of potential water quality impacts associated with open water disposal of dredged material. It is used in conjunction with appropriate testing and evaluation of potential benthic impacts in order to determine suitability of dredged material for open water disposal.

The ITM provides for preliminary (Tier I) screening of potential water column impacts on the basis of existing information. The manual then states, "If a water quality standard (WQS) determination cannot be made in Tier I, Tier II evaluation is necessary to determine whether the discharge complies with 230.10(b)(1)" (which pertains to compliance with water quality standards and other considerations as spelled out in CFR 40 Part 230 *Section 404(b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material, Subpart B--Compliance With the Guidelines,* Sec. 230.10 *Restrictions on discharge*).

The ITM also states, "The discharge of dredged material cannot cause the WQS to be exceeded outside the mixing zone unless the State provides a variance to the standard. There are two approaches for the Tier II water column evaluation for WQS compliance. One approach is to use the numerical models provided in Appendix C of the ITM as a screen, assuming that all of the contaminants in the dredged material are released into

the water column during the disposal process. The other approach applies the same model with results from chemical analysis of the elutriate test."

The assumption that all of the contaminants in the dredged material are released into the water column is overly conservative. Typically only a fraction of the contaminants sorbed to sediment are leachable, and desorption of that fraction may take place over a relatively long period of time in some instances. For this reason, the standard elutriate test is considered a better indicator of expected water quality impacts associated with open water disposal. Dissolved contaminant concentrations in the elutriate are compared to applicable water quality standards or water quality criteria (WQC) to determine whether there are any exceedances. For those contaminants where exceedances are noted, the degree of dilution required to meet water quality standards can be determined and the size of mixing zone required to achieve this dilution calculated using parameters specific to the proposed disposal site. If a definitive determination cannot be made as a result of analytical limitations (as when criteria are lower than analytical reporting limits, for example) or if there is concern regarding contaminants for which there are no available water quality criteria, or concern regarding potential interactive effects, Tier III toxicity testing is used to determine dilution requirements. Based on the results of elutriate toxicity testing, an LC50 value is calculated. The LC50 represents the dilution at which 50% mortality of the test organisms is expected. The minimum dilution required is then equal to 0.01 times the LC50 dilution. Where no elutriate toxicity tests result in 50% or greater mortality, but the mortality in the elutriate without dilution is statistically greater than the control, expert judgment is required to determine a scientifically defensible dilution. One might choose one of:

- A one-hundredfold dilution (0.01 times 100% concentration) if substantial mortality occurs at more than one dilution of the elutriate.
- The dilution at which no statistically significant mortality was observed.
- The dilution required to meet a suitably conservative alternative water quality criteria deemed acceptable to all stakeholders and regulatory agencies.

If adequate dilution can be achieved within an area meeting the State requirements for mixing zones, open water disposal would be permitted

on the basis of water quality standards, assuming other requirements of open water disposal are met (no benthic toxicity).

Data evaluation and dilution requirements

Standard elutriates were prepared by ERDC and samples split for toxicity testing and chemical analysis. Toxicity testing was performed at ERDC and chemical analysis by Test America. Water samples were obtained from the existing Mississippi River (MR) open water disposal site near the mouth of the Inner Harbor Navigation Canal in New Orleans and analyzed by Test America for background concentrations of contaminants of concern (COCs). Water samples were also taken for analysis from the proposed wetland mitigation site near Bayou Bienvenue.

Mean and maximum dissolved contaminant concentrations were determined for each constituent, utilizing the results obtained from all DMMU standard elutriates composites (Table 25). For calculation of the means, a value of half the reporting limit (0.5RL) was assumed for all non-detects. Where the maximum elutriate concentration was less than the laboratory reporting limit (RL) for that sample, the highest qualified value was assumed to represent the maximum. Where the maximum elutriate concentration was less than the RL *and* there were no qualified values (all samples were non-detect), it was assumed the compound was not present and no dilutions were calculated.

If adequate mixing is available to dilute the maximum predicted concentrations for each contaminant to its water quality criteria or to meet the dilution required on the basis of toxicity testing, within an acceptable mixing zone, then mixing can be achieved for all materials. Geometric means were also calculated, however, in order to evaluate mixing zone requirements for the majority of the dredged material. The geometric mean takes into account the influence of a few high or low values on the mean. Where the geometric mean is much lower than the arithmetic mean, it suggests that with the exception of when high concentration areas are dredged, effluent concentrations are generally better represented by the geometric mean. Also, the mixing that occurs during dredging may have the effect of reducing effluent concentrations from the observed maximums somewhat.

Table 25. Standard elutriate results - dissolved fraction.

Component Name	Mean	Geometric Mean	Maximum	Units	MDL	RL	Qualifier	Sample
Group I: Measured values ≥ RL (cont.)								
1,4-Dichlorobenzene	0.106	0.104	0.190	µg/L	0.046	0.190		7_4- NN
2-Methylnaphthalene	0.153	0.107	2.30	µg/L	0.047	0.200		7_9-F
4,4'-DDD	0.00814	0.00299	0.160	µg/L	0.004	0.025	PG N	7_2- NN
4,4'-DDE	0.00574	0.00202	0.0870	µg/L	0.003	0.025	PG	7_2- NN
4,4'-DDT	0.00767	0.00341	0.0620	µg/L	0.001	0.003	PG	4_5- NN
4-Methylphenol	0.456	0.417	1.10	µg/L	0.069	0.940		10_C3&4- FN
Acenaphthene	0.317	0.161	4.10	µg/L	0.049	0.190		4_5- NN
Aldrin	0.00522	0.00224	0.0510	µg/L	0.001	0.003	PG N	4_5- NN
alpha-Chlordane	0.00190	0.00146	0.0150	µg/L	0.001	0.003	PG N	5_4- NN
Aluminum	26006	450	1420000	µg/L	12.1	300		10_C3&4- FN
Ammonia as Nitrogen	9.14	8.17	16.9	mg/L	0.047	0.500	J	4_C1_3- NN
Anthracene	0.160	0.122	1.30	µg/L	0.048	0.190		4_5- NN
Antimony	3.28	2.63	14.8	µg/L	0.240	10.0		7_2- NN
Aroclor 1016	0.0136	0.0105	0.160	µg/L	0.005	0.019		4_5- NN
Aroclor 1242	0.0184	0.0107	0.390	µg/L	0.004	0.019		7_2- NN
Aroclor 1248	0.0655	0.0174	1.50	µg/L	0.004	0.019		5_4- NN
Aroclor 1254	0.0841	0.0185	0.930	µg/L	0.004	0.019		4_5- NN
Aroclor 1260	0.0684	0.0168	1.40	µg/L	0.003	0.019		7_2- NN
Aroclors (Total)	0.217	0.0304	2.80	µg/L	0.006	0.019		5_4- NN
Arsenic	10.8	7.12	210	µg/L	1.40	10.0		10_C3&4- FN
Barium	985	748	6460	µg/L	0.760	100		10_C3&4- FN
Benzo(a)anthracene	0.114	0.101	1.00	µg/L	0.039	0.190		4_5- NN
Benzo(a)pyrene	0.101	0.0980	0.370	µg/L	0.041	0.190		4_5- NN
Benzo(b)fluoranthene	0.104	0.0984	0.510	µg/L	0.029	0.190		4_5- NN
Benzo(k)fluoranthene	0.0986	0.0976	0.210	µg/L	0.037	0.190		4_5- NN
Beryllium	2.79	1.73	60.4	µg/L	0.680	10.0		10_C3&4- FN
beta-BHC	0.00550	0.00211	0.065	µg/L	0.001	0.003	PG N	2_C1_6- NN
bis(2-Ethylhexyl) phthalate	0.937	0.587	5.70	µg/L	0.110	0.950		7_4- NN
Group I: Measured values ≥ RL (cont.)								
Cadmium	2.24	1.85	15.6	µg/L	1.10	10.0		10_C3&4- FN
Calcium	173000	144000	413000	µg/L	31.3	500		7_9-F
Chromium	30.2	6.55	1350	µg/L	1.100	20.0	J	10_C3&4- FN
Chromium III	42.0	6.75	1350	µg/L	0.270	2.00		10_C3&4- FN
Chromium VI	0.0521	0.0056	2.5	mg/L	0.0026	0.01		10_C3&4- FN
Chrysene	0.107	0.0969	0.770	µg/L	0.033	0.190		4_5- NN
Copper	35.7	5.01	1730	µg/L	1.40	20.0		10_C3&4- FN
Cyanide, Total	4.34	3.81	14.2	µg/L	1.70	10.0		4_5- NN
delta-BHC	0.00969	0.00374	0.120	µg/L	0.000	0.003	PG N	4_5- NN

Component Name	Mean	Geometric Mean	Maximum	Units	MDL	RL	Qualifier	Sample
Dibenzofuran	0.416	0.349	1.10	µg/L	0.050	0.940		4_5- NN
Dibutyltin	0.0814	0.0285	1.50	µg/L	0.010	0.780		4_4- NN
Dieldrin	0.00477	0.00181	0.0980	µg/L	0.004	0.025	PG N	7_2- NN
Endosulfan I[1]	0.00183	0.00146	0.0057	µg/L	0.000	0.003		4_5- NN
Endosulfan II	0.00282	0.00190	0.0140	µg/L	0.001	0.003	PG N	8_C1_4- NN
Endosulfan sulfate	0.00673	0.00278	0.0570	µg/L	0.008	0.025		7_2- NN
Endrin	0.00443	0.00197	0.0580	µg/L	0.000	0.003		4_5- NN
Endrin aldehyde	0.00235	0.00171	0.0160	µg/L	0.001	0.003	PG	4_5- NN
Fluoranthene	0.234	0.124	4.80	µg/L	0.047	0.190		4_5- NN
Fluorene	0.201	0.124	3.00	µg/L	0.051	0.190		4_5- NN
gamma-BHC (Lindane)	0.00374	0.00286	0.0160	µg/L	0.001	0.003	PG N	7_3- NN
gamma-Chlordane	0.00703	0.00286	0.0740	µg/L	0.004	0.025	PG	7_2- NN
Heptachlor	0.00927	0.00285	0.100	µg/L	0.001	0.003	PG N	4_5- NN
Heptachlor epoxide	0.00524	0.00201	0.0540	µg/L	0.000	0.003	PG	5_4- NN
Lead	21.3	2.32	1050	µg/L	0.200	10.0		10_C3&4- FN
Mercury	0.130	0.101	1.90	µg/L	0.055	0.200		10_C3&4- FN
Methoxychlor	0.00657	0.00339	0.0720	µg/L	0.001	0.005	PG	4_5- NN
Naphthalene	0.116	0.0991	0.820	µg/L	0.043	0.200		9_1- NN
Nickel	17.9	3.64	773	µg/L	0.730	10.0		10_C3&4- FN
N-Nitrosodiphenylamine	0.111	0.101	0.850	µg/L	0.046	0.190		7_4- NN
pH	7.77	7.77	8.70	No Units				9_C2&4- NN
Phenanthrene	0.332	0.154	6.90	µg/L	0.052	0.190		4_5- NN
Phenol	0.141	0.114	1.20	µg/L	0.021	0.190		4_7_- NN
Pyrene	0.209	0.127	3.20	µg/L	0.053	0.190		4_5- NN
Selenium	34.7	29.1	103	µg/L	2.10	50.0	J	10_C3&4- FN
Thallium	1.09	0.516	11.6	µg/L	0.180	10.0		10_C3&4- FN
Tin	12.9	11.7	77.7	µg/L	7.60	50.0		10_C3&4- FN
Total Organic Carbon	7.58	7.12	20.4	mg/L				9_C2&4- NN
Group I: Measured values ≥ RL (cont.)								
Total Suspended Solids	13.9	10.4	56.0	mg/L	3.40	4.00		7_2- NN
TPH (as Diesel)	1970	598	29000	µg/L	940	2000		7_2- NN
TPH (as Gasoline)	60.9	47.4	870	µg/L	28.0	100	B	7_2- NN
Tributyltin	0.520	0.0531	13.0	µg/L	0.012	0.900		4_4- NN
Zinc	64.1	11.9	2910	µg/L	6.00	50.0		10_C3&4- FN
Group II: Maximum Value <RL, highest detected value shown								
2,4,6-Trichlorophenol	0.479	0.470	0.0700	µg/L	0.055	0.960	J	10_1- NN
2,4-DB	1.93	1.89	3.00	µg/L	0.590	4.00	J PG	7_9-F
2,4-Dichlorophenol	0.0967	0.0965	0.0600	µg/L	0.047	0.190	J	10_1- NN
2-Chloronaphthalene	0.0967	0.0965	0.0610	µg/L	0.042	0.190	J	10_1- NN

Component Name	Mean	Geometric Mean	Maximum	Units	MDL	RL	Qualifier	Sample
2-Nitrophenol	0.480	0.472	0.0950	µg/L	0.052	0.960	J	10_1- NN
4-Bromophenyl phenyl ether	0.480	0.472	0.0950	µg/L	0.048	0.960	J	10_1- NN
4-Nitrophenol	2.40	2.39	1.60	µg/L	0.067	4.80	J	10_1- NN
Acenaphthylene	0.0968	0.0966	0.0640	µg/L	0.044	0.190	J	10_1- NN
alpha-BHC	0.00190	0.00153	0.00560	µg/L	0.001	0.003	PG	2_C1_6- NN
Benzo(ghi)perylene	0.0966	0.0958	0.120	µg/L	0.026	0.190	J	4_5- NN
Benzoic acid	2.27	2.10	3.40	µg/L	0.400	4.80	J	7_4- NN
Butyl benzyl phthalate	0.449	0.433	0.480	µg/L	0.130	0.960	J	10_1- NN
Dalapon	1.02	1.01	1.90	µg/L	0.520	2.00	J	10_1- NN
Dibenz(a,h)anthracene	0.0964	0.0959	0.0430	µg/L	0.033	0.190	J	4_5- NN
Diethyl phthalate	0.481	0.479	0.520	µg/L	0.230	0.940	J	4_7_- NN
Di-n-butyl phthalate	0.435	0.401	0.350	µg/L	0.045	0.960	J	10_1- NN
Di-n-octyl phthalate	0.479	0.466	0.0430	µg/L	0.041	0.960	J	10_1- NN
Indeno(1,2,3-cd)pyrene	0.0978	0.0977	0.120	µg/L	0.045	0.190	J	4_5- NN
Pentachlorophenol	0.492	0.491	0.780	µg/L	0.080	0.960	J	10_1- NN
Silver	2.57	2.54	6.30	µg/L	0.770	10.0	B	10_C3&4- FN
Group III: All Samples Non-Detect								
1,2,4-Trichlorobenzene	0.0973	0.0973	0.105	µg/L	0.042	0.210	U	
1,2-Dichlorobenzene	0.0973	0.0973	0.105	µg/L	0.033	0.210	U	
1,2-Diphenylhydrazine	0.0973	0.0973	0.105	µg/L	0.047	0.210	U	
1,3-Dichlorobenzene	0.0973	0.0973	0.105	µg/L	0.039	0.210	U	
2,2'-oxybis(1-Chloropropane)	0.0973	0.0973	0.105	µg/L	0.027	0.210	U	
2,4,5-T	0.500	0.500	0.500	µg/L	0.170	1.00	U	
2,4,5-TP (Silvex)	0.500	0.500	0.500	µg/L	0.160	1.00	U	
2,4-D	2.00	2.00	2.00	µg/L	1.50	4.00	U	
2,4-Dimethylphenol	0.487	0.486	0.550	µg/L	0.055	1.10	U	
Group III: All Samples Non-Detect (cont)								
2,4-Dinitrophenol	2.44	2.43	2.65	µg/L	1.40	5.30	U	
2,4-Dinitrotoluene	0.487	0.486	0.550	µg/L	0.048	1.10	U	
2,6-Dinitrotoluene	0.487	0.486	0.550	µg/L	0.054	1.10	U	
2-Chlorophenol	0.487	0.486	0.550	µg/L	0.048	1.10	U	
3,3'-Dichlorobenzidine	0.487	0.486	0.550	µg/L	0.043	1.10	U	
4,6-Dinitro-2-methylphenol	2.44	2.43	2.65	µg/L	1.50	5.30	U	
4-Chloro-3-methylphenol	0.487	0.486	0.550	µg/L	0.063	1.10	U	
4-Chlorophenyl phenyl ether	0.487	0.486	0.550	µg/L	0.045	1.10	U	
Aroclor 1221	0.00962	0.00961	0.0100	µg/L	0.005	0.020	U	
Aroclor 1232	0.00962	0.00961	0.0100	µg/L	0.006	0.020	U	
Benzidine	9.73	9.73	10.50	µg/L	6.00	21.0	U	

Component Name	Mean	Geometric Mean	Maximum	Units	MDL	RL	Qualifier	Sample
bis(2-Chloroethoxy)methane	0.487	0.486	0.550	µg/L	0.130	1.10	U	
bis(2-Chloroethyl) ether	0.0973	0.0973	0.105	µg/L	0.049	0.210	U	
Chlordane (technical)	0.0157	0.0133	0.120	µg/L	0.071	0.240	U	
Diazinon	0.483	0.483	0.500	µg/L	0.120	1.00	U	
Dicamba	1.00	1.00	1.00	µg/L	0.330	2.00	U	
Dichlorprop	2.00	2.00	2.00	µg/L	0.720	4.00	U	
Dimethyl phthalate	0.487	0.486	0.550	µg/L	0.045	1.10	U	
Dinoseb	0.300	0.300	0.300	µg/L	0.260	0.600	U	
Hexachlorobenzene	0.0973	0.0973	0.105	µg/L	0.046	0.210	U	
Hexachlorobutadiene	0.0973	0.0973	0.105	µg/L	0.040	0.210	U	
Hexachlorocyclopentadiene	0.487	0.486	0.550	µg/L	0.085	1.10	U	
Hexachloroethane	0.487	0.486	0.550	µg/L	0.046	1.10	U	
Isophorone	0.487	0.486	0.550	µg/L	0.050	1.10	U	
MCPA	200	200	200	µg/L	94.0	400	U	
MCPP	200	200	200	µg/L	130	400	U	
Monobutyltin	0.418	0.292	5.00	µg/L	0.050	10.0	U	
Nitrobenzene	0.0973	0.0973	0.105	µg/L	0.068	0.210	U	
N-Nitrosodimethylamine	0.487	0.486	0.550	µg/L	0.048	1.10	U	
N-Nitrosodi-n-propylamine	0.0973	0.0973	0.105	µg/L	0.063	0.210	U	
Tetrabutyltin	0.0396	0.0285	0.500	µg/L	0.009	1.00	U	
Toxaphene	0.00164	0.00139	0.0125	µg/L	0.007	0.025	U	

B Compound was detected in the method blank. J Compound detected but below the reporting limit (the value given is an estimate).

N The RPD between the results from both columns is > 100%. PG The % difference between the results from both columns is >40% (SW846).

U Compound analyzed but not detected.

Elutriate concentrations (maximum and geometric mean values) were compared to the most conservative of acute and chronic Federal and State of Louisiana water quality criteria. Where no such criteria existed, EPA Region 4 water quality screening criteria for hazardous waste sites were used, if available. Where elutriate concentrations exceeded either acute or chronic water quality standards, dilutions were calculated using background concentrations of the receiving waters (Mississippi River and proposed mitigation site). Dilution requirements are expressed as the dilution ratio, which is the ratio of receiving water volume to effluent volume. Where background concentrations exceeded the standard, dilution was calculated to 10% above background. Dilutions were also calculated based on results of the Tier III Toxicity Tests and the LC50 values.

Two elutriate samples were problematic in the analysis. The aluminum concentration for DMMU 10 sample C3&4-FN was three orders of magnitude higher than the other samples, and concentrations were one to two orders of magnitude higher for all other metals except selenium and silver. The aluminum concentration reported for this sample was 1.42 g/L, suggesting the sample contained colloidal clays and that the aluminum concentration reported was actually derived from the clay matrix rather than the dissolved phase. This could be responsible for the elevation of other metals concentrations as well, although total suspended solids were comparable to that of the other samples. There are several other inconsistencies relative to this and another composite obtained at this location as well. Metals concentrations were elevated in the elutriate of DMMU 10 sample C3&4-F, yet this sample only required a dilution of one based on toxicity, and benthic toxicity of the sediment was not significantly different from controls. Toxicity of the elutriate of DMMU 10 sample C3&4-FN was the highest of all samples tested, but was still of the same order of magnitude as samples taken from various locations throughout the project area. Benthic toxicity was significantly higher than control for the sediment from DMMU 10 sample C3&4-FN, but the difference in mortality was less than 20% (the threshold at which benthic toxicity would preclude open water disposal). Concentrations of organic compounds were not appreciably elevated in either of these elutriates, and metals were not elevated in the sediment of either of these two composites. For both elutriate samples, pH was at the upper range reported for all elutriates, which would tend to limit metals solubilization rather than facilitate it. Given these inconsistencies, the results obtained for metals analysis for the elutriate of DMMU 10 sample C3&4 - FN were considered unreliable and the next highest concentration measured was taken for the purposes of calculating maximum dilutions. Mean dilutions were calculated using the geometric mean, which better reflects the central tendency of the data than the arithmetic mean in cases where there are a few extreme data points. Affected compounds are footnoted in these tables.

A few standard elutriate samples were rejected in the data validation, and these data points were removed from the database before dilutions were calculated. The impact on dilution requirements was minimal in any case, since two of the affected compounds have no water quality criteria, and three samples were non-detect, having little impact on mean effluent concentrations. Affected samples are summarized in Table 26.

Table 26. Standard elutriate data validation rejects.

Sample	Compound
10_1 - NN	3,3'-Dichlorobenzidine
4_5 - NN	Chromium, hexavalent
4_7_ - NN	Chromium, hexavalent
10_C3&4 - FN	Chromium, hexavalent
10_0C3&4 - F	Mercury-DISS
6_1 - NN	Monobutyltin
6_3 - F	Monobutyltin
6_4 - F	Monobutyltin
6_5 - F	Monobutyltin
6_1 - N	Monobutyltin
6_3 - FN	Monobutyltin
6_4 - FN	Monobutyltin

MR site dilution requirements

For disposal in the MR disposal site, a maximum dilution of 69, for barium, was required to meet freshwater acute criteria, and a maximum dilution of 697, for total PCBs, was required to meet freshwater chronic criteria (Table 27). Dilutions based on mean (geometric mean) elutriate concentrations (Table 28) resulted in a maximum dilution requirement of 18 to meet freshwater acute criteria, and a dilution requirement of 90 to meet freshwater chronic criteria (both for barium).

Maximum dilutions obtained based on toxicity testing of freshwater elutriates ranged from 1 to 384 (Table 29), with the elutriate of DMMU 10 sample C3&4 - FN setting the upper end of dilution requirements.

Mitigation site dilution requirements

Sediment from some DMMUs has been ruled out for open water disposal on the basis of benthic toxicity (see Table 1, Dredging and Disposal Plan (USAE-ERDC 2008). Those areas include DMMUs 1 and 2, 4 and 5, and part of DMMUs 3 and 9. Some of these materials are suitable for placement in a freshwater environment but not in a marine environment, or for placement in a marine but not freshwater environment. For simplicity, all elutriate data were initially considered in the mixing zone analysis on the premise that if maximum required dilutions could be achieved, no further breakdown of the data would be necessary. For the MR disposal site, this proved to be true. For the mitigation site, however,

exclusion of some materials on the basis of water column impacts was found to be necessary. Also, method of containment within the mitigation site is yet to be determined, requiring consideration of both standard and modified elutriate results. For this reason, dilution and mixing requirements for placement in the mitigation site are treated separately in the section titled "Mixing evaluation for placement of dredged material in the proposed mitigation site" (page 105).

Mixing

Using physical and chemical properties of the receiving water at the MR disposal site, attainable dilution was calculated for high and low flow receiving water conditions for barge dump and for continuous pipeline discharge. STFATE was used to model barge dumping of mechanically dredged sediment and CDFATE was used to model continuous discharge of hydraulically dredged sediment. STFATE and CDFATE are programs in the USACE ADDAMS models (http://el.erdc.usace.army.mil/elmodels/pdf/ee-06-12.pdf).

Figures 14 through 17 illustrate the distance required to achieve a specified dilution ratio for the different conditions assumed. These figures show that a dilution of 700 can be achieved for high flow conditions (Figures 14 and 15) in approximately:

- 1000 ft for pipeline discharge
- 1000 ft for barge discharge

For low flow conditions (Figures 16 and 17), a dilution of 700 can be achieved in approximately:

- 2100 ft for pipeline discharge
- 1400 ft for barge discharge

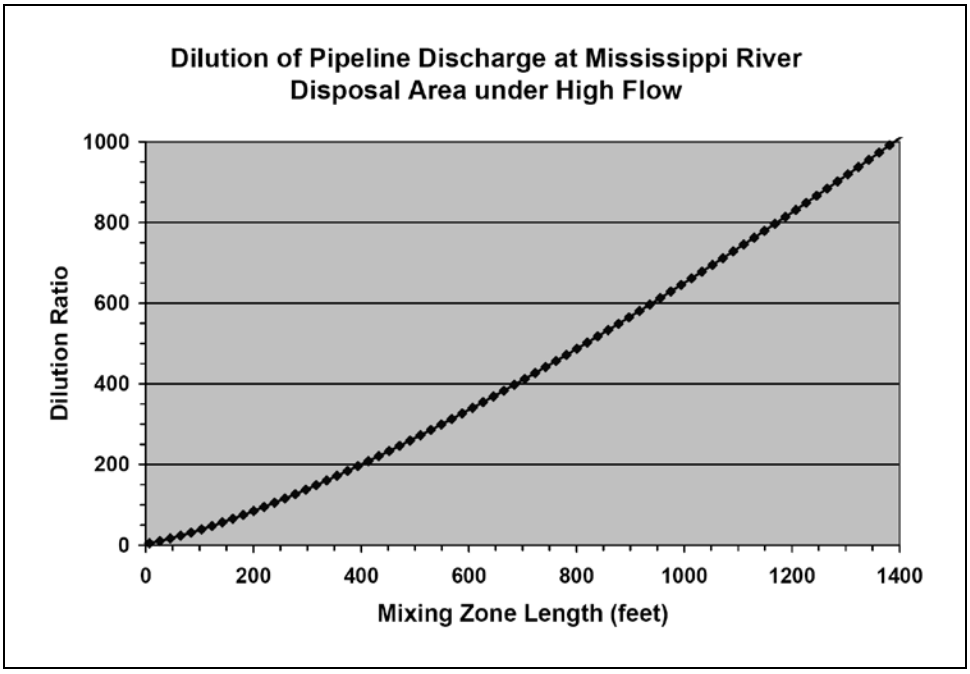

Figure 14. Dilution ratio as a function of distance for pipeline disposal under high flow conditions.

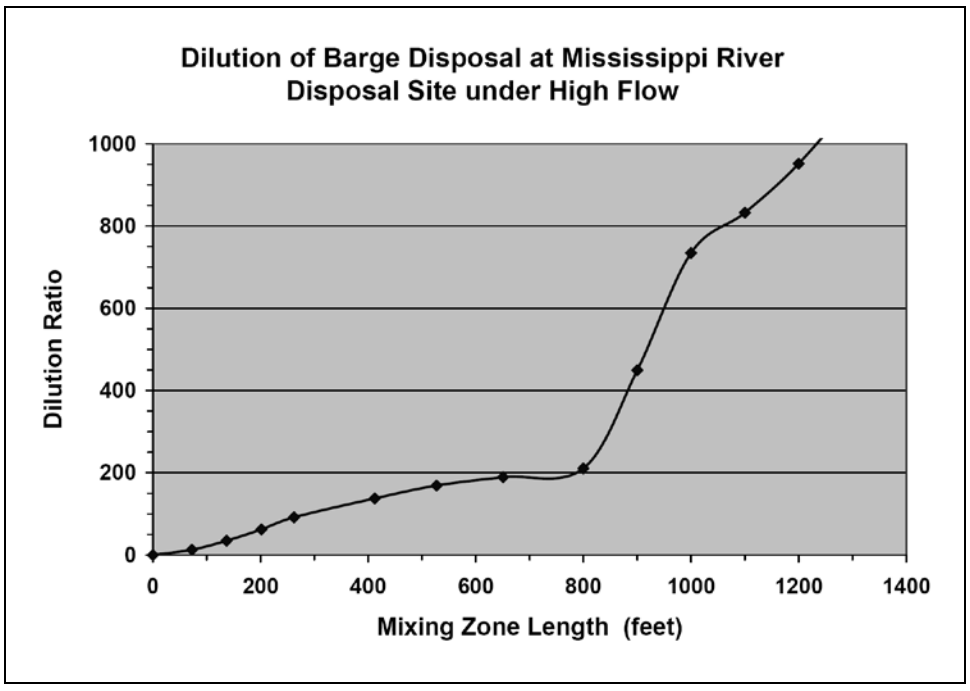

Figure 15. Dilution ratio as a function of distance for barge disposal under high flow conditions.

Table 27. Maximum standard elutriate concentration, Mississippi River background concentrations, available freshwater criteria/standards and dilution ratios for open water disposal in Mississippi River disposal site.

		Mississippi River Water Concentration		Federal				US EPA Region 4		State of Louisiana				Dilution Ratios	
				Primary		Primary & Secondary		Water Quality Screening Values for Hazardous Waste Sites				Minimum Federal or Louisiana Acute Criteria or Standard	Minimum Federal or Louisiana Chronic Criteria or Standard		
Contaminants	Maximum Elutriate Concentration	Reported	Assumed	Acute Toxicity Primary Criteria	Chronic Toxicity Primary Criteria	Acute Toxicity Criteria	Chronic Toxicity Criteria	Acute Toxicity Criteria	Chronic Toxicity Criteria	Acute Standards	Chronic Standards			Meeting Acute Criteria	Meeting Chronic Criteria
	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L		
Metals															
Aluminum	4690	11.3BJ	11	750a	87a	750a	87a	750	87			750	87	**5**	**61**
Antimony	14.8	0.09B	0.090			180b	30b	1300	160			180	30	0	0
Arsenic	11.9	1.80	1.800	340	150	66c	3.1d	340e	150e	339.8	150	339.8	150	0	0
Barium	2590	74.1	74.100			110b	4b					110	4	**69**	**339**
Beryllium	3.00	1U	0.500			35b	0.66b	16	0.053			35	1	0	**15**
Cadmium	15.6	1U	0.5	2.0	.25	2.0	.25	2.0	.25	15n	0.62n	2.0	.25	**9**	**301**
Chromium III	693	3.50	3.500	570	74	570	74	570	74	310n	103n	310	74	**1.25**	**8.78**
Chromium VI	13.0	10U	5.000	16	11	16	11	16	11	16	11	16	11	0	**0.33**
Copper	14.1	2.1J	2.100	13	9	13	9	13	9	10n	7n	10	7	**0.52**	**1.45**
Lead	9.90	0.34BJ	0.340	65	2.5	65	2.5	65	3	30n	1.2n	30	1	0	**10**
Mercury	0.170	0.2U	0.100	1.4	0.77	1.4	0.77	1.4	0.77	2.04	0.01	1	0.01	0	**6**
Nickel	7.20	1.50	1.500	470	52	470	52	470	52	788n	88n	470	52	0	0
Selenium	61.2r	0.89B	0.890		5q	20f	5	20g	5.00			20	5	**2**	**14**
Silver	1.25	1U	0.5	3.2		3.2	0.36b	3.2	0.012			3.2	0.36	0	**14**
Thallium	1.25	0.031BJ	0.031			110b	12b	140	4			110	12	0	0
Tin	1.25	1.6B	1.600			2700b	73b					2700	73	0	0
Zinc	49.8	8.70	8.700	120	120	120	120	120	120	64m	58m	64	58	0	0
Organotins															
Dibutyltin	1.50	0.037U	0.019											NS[1]	NS
Monobutyltin														NS	NS
Tetrabutyltin														NS	NS
Tributyltin	13.0	0.043U	0.022	0.46h	0.072h	0.46h	0.072h		0.026			0.46	0.072	**29**	**256**
Inorganic/General Chemistry															
Cyanide	14.2	10U	5.000	22	5.2	22	5.2	22	5.2	45.9	5.4	22	5.2	0	**17**
Ammonia-N	16900	68B	68.000	17000i	1900i							17000	1900	0	**8**
PAHs															
2-Methylnaphthalene	2.30	.19U	0.095											NS	NS
Acenaphthene	4.10	.19U	0.095			80f	23f	170	17			80	23	0	0
Acenaphthylene	0.105	.19U	0.095											NS	NS
Anthracene	1.30	.19U	0.095			13b	0.73b					13	0.73	0	**0.9**

Contaminants	Maximum Elutriate Concentration	Mississippi River Water Concentration		Federal				US EPA Region 4		State of Louisiana		Minimum Federal or Louisiana Acute Criteria or Standard	Minimum Federal or Louisiana Chronic Criteria or Standard	Dilution Ratios	
				Primary		Primary & Secondary		Water Quality Screening Values for Hazardous Waste Sites		Acute Standards	Chronic Standards				
		Reported	Assumed	Acute Toxicity Primary Criteria	Chronic Toxicity Primary Criteria	Acute Toxicity Criteria	Chronic Toxicity Criteria	Acute Toxicity Criteria	Chronic Toxicity Criteria					Meeting Acute Criteria	Meeting Chronic Criteria
	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L		
Benzo(a)anthracene	1.00	.19U	0.095			0.49b	0.027b					0.49	0.027	**1**	**94**
Benzo(a)pyrene	0.370	.19U	0.095			0.24b	0.014b					0.24	0.014	**0.90**	**28**
Benzo(b)fluoranthene	0.510	.19U	0.095											NS	NS
Benzo(g,h,i)perylene	0.120	.19U	0.095											NS	NS
Benzo(k)fluoranthene	0.210	.19U	0.095											NS	NS
Chrysene	0.770	.19U	0.095											NS	NS
Dibenzo(a,h)anthracene	0.105	.19U	0.095											NS	NS
Dibenzofuran	1.10	.95U	0.475			66b	3.7b					66	3.7	0	0
Fluoranthene	4.80	.19U	0.095			33.6f	6.16f	398	39.8			33.6	6.16	0	0
Fluorene	3.00	.19U	0.095			70b	3.9b					70	3.9	0	0
Indeno(1,2,3-c,d)pyrene	0.120	.19U	0.095											NS	NS
Naphthalene	0.820	.19U	0.095			190b	12b	230	62			190	12	0	0
Phenanthrene	6.90	.083J	0.083			30f	6.3f					30	6.3	0	**0.1**
Pyrene	3.20	.19U	0.095											NS	NS
Semi-Volatile Organic Compounds															
1,4-Dichlorobenzene	0.190	.076J	0.076			180b	15b	112	11.2			180	15	0	0
2,4,6-Trichlorophenol	0.550	.95U	0.475				970f	32	3.2				970	0p	0
2,4-Dichlorophenol	0.105	.19U	0.095			2020f	365f	202	36.5	202	101	202	101	0	0
2-Chloronaphthalene	0.105	.19U	0.095			1600f						1600		0	NS
2-Nitrophenol	0.550	.95U	0.475			230f	150f		3500			230	150	0	0
4-Bromophenyl phenyl ether	0.550	.95U	0.475				1.5b						1.5	NS	0
4-Methylphenol (p-Cresol)	1.10	.95U	0.475											NS	NS
4-Nitrophenol	2.65	4.8U	2.4			1200b	300b	828	82.8			1200	300	0	0
Benzoic acid	3.40	4.8U	2.4			740b	42b					740	42	0	0
Benzyl butyl phthalate	0.550	.95U	0.475				19b	330	22				19	0p	0
Bis(2-ethylhexyl) phthalate	5.70	.22J	0.220			27b	3b	1110	<0.3			27	3	0	**1.0**
Diethyl phthalate	0.550	.95U	0.475			1800b	210b	5210	521			1800	210	0	0
Di-n-butyl phthalate	0.550	.95U	0.475			190b	35b	94	9.4			190	35	0	0
Di-n-octyl phthalate	0.550	.95U	0.475				708i						708	NS	0
N-Nitrosodiphenylamine	0.850	.19U	0.095			3800b	210b	585	58.5			3800	210	0	0
Pentachlorophenol	0.780	.95U	0.475	19	15	19b	15b	19j	15k			19	15	0	0
Phenol	1.20	.19U	0.095			3600f	110f	1020	256	700	350	700	350	0	0

Contaminants	Maximum Elutriate Concentration	Mississippi River Water Concentration		Federal				US EPA Region 4		State of Louisiana		Minimum Federal or Louisiana Acute Criteria or Standard	Minimum Federal or Louisiana Chronic Criteria or Standard	Dilution Ratios	
				Primary		Primary & Secondary		Water Quality Screening Values for Hazardous Waste Sites		Acute Standards	Chronic Standards			Meeting Acute Criteria	Meeting Chronic Criteria
		Reported	Assumed	Acute Toxicity Primary Criteria	Chronic Toxicity Primary Criteria	Acute Toxicity Criteria	Chronic Toxicity Criteria	Acute Toxicity Criteria	Chronic Toxicity Criteria						
	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L		
Chlorinated Pesticides															
4,4'-DDD	0.160	.00093J PG	0.001			0.19b	0.011b	0.064	0.0064	0.030	0.006	0.03	0.006	**4**	**30**
Aldrin	0.051	.0026U	0.001	3		3		3	0.3	3		3		0	0p
alpha-BHC	0.013	.0026U	0.001			39b	2.2b		500			39	2.2	0	0
alpha-Chlordane	0.015	.0026U	0.001	2.4m	0.0043m	2.4m	0.0043m	2.4m	0.0043m			2.4	0.0043	0	**4**
beta-BHC	0.065	.0026U	0.001			39b	2.2b		5000			39	2.2	0	0
delta-BHC	0.120	.0026U	0.001			39b	2.2b					39	2.2	0	0
Dieldrin	0.098	.0026U	0.001	0.24	0.056	0.24	0.056	0.24	0.0560	0.2374	0.0557	0.2374	0.0557	0	**0.8**
Endosulfan I	0.013	.0026U	0.001	0.22	0.056	0.22	0.056	0.22	0.056	0.220	0.0560	0.22	0.056	0	0
Endosulfan II	0.014	.0026U	0.001	0.22	0.056	0.22	0.056	0.22	0.056			0.22	0.056	0	0
Endosulfan sulfate	0.057	.0026U	0.001											NS	NS
Endrin	0.058	.0014J PG N	0.001	0.086	0.036	0.086	0.036	0.086	0.0360	0.0864	0.0375	0.086	0.036	0	**0.6**
Endrin aldehyde	0.016	.0037PG N	0.004											NS	NS
gamma-BHC (Lindane)	0.016	.0015J PG	0.002	0.95		0.95		0.95	0.08	5.3	0.210	0.9500	0.2100	0	0
gamma-Chlordane	0.074	.0025J	0.003	2.4m	0.0043m	2.4m	0.0043m	2.4m	0.0043m			2.4	0.0043	0	**39**
Heptachlor	0.100	.0026U	0.001	0.52	0.0038	0.52	0.0038	0.52	0.0038			0.52	0.0038	0	**38**
Heptachlor epoxide	0.054	.0026U	0.001	0.52	0.0038	0.52	0.0038	0.52	0.0038			0.52	0.0038	0	**20**
Methoxychlor	0.072	.005U	0.003		0.03h		0.03h		0.03				0.03	NS	**2**
p,p'-DDE (4,4')	0.087	.0026U	0.001					105	10.5					0p	0p
p,p'-DDT (4,4')	0.062	.0014J	0.001	1.1	0.001	1.1	0.001	1.1	0.001	1.1	0.001	1.1	0.001	0	**432**
PCBs															
PCB(Aroclor-1016)	0.160	.02U	0.010					0.2	0.014					0p	**36.5p**
PCB(Aroclor-1242)	0.390	.02U	0.01			1.2b	0.53b	0.2	0.014			1.2	0.53	0	0
PCB(Aroclor-1248)	1.50	.02U	0.010			1.4b	0.081b	0.2	0.014			1.4	0.0810	**0.1**	**20**
PCB(Aroclor-1254)	0.930	.02U	0.010			0.6b	0.033b	0.2	0.014			0.6	0.033	**0.6**	**39**
PCB(Aroclor-1260)	1.40	.02U	0.010			1700b	94b	0.2	0.014			1700	94	0	0
PCB Total	2.80	.02U	0.010		0.014	2f	0.014		0.014	2.0	0.014	2	0.014	**0.4**	**697**
													Maximum	**69**	**697**
													Average	**2**	**38**
													Minimum	**0**	**0**

1 NS - No standard

a Non-priority pollutant pH 6.5-9, **b** secondary value, **c** As III 340 µg/L, As V 66 mg/L (secondary value), **d** As III 150 µg/L, As V 3.1 µg/L (secondary value), **e** As III, **f** outdated national ambient water quality standard, **g** the CMC=1/[(f1/CMC1)+(f2/CMC2)] where f1 and f2 are the fractions of total selenium that are treated as selenite and selenate, respectively, and CMC1 and CMC2 are 185.9 µg/L and 12.83 µg/L, respectively, **h** non-priority pollutant, **i** federal EPA criteria for Ammonia, pH 7.6 & salmonids absent acute, pH 7.6 and T 26 deg C chronic, **j** at pH 7.8, pH dependent criteria e^(1.005pH-4.83), **k** at pH 7.8, pH dependent criteria e^(1.005pH-5.29), **m** chlordane species not specified, **n** harness dependent criteria, values from Weston IHNC database WQC summary 6 1 2008, **p** Based on EPA Region IV screening water quality criteria for hazardous waste sites, **q** total concentrations, **r** dissolved concentration (total concentrations not measured in SE)

B Compound was detected in the method blank. **J** Compound detected but below the reporting limit (the value given is an estimate). **N** The RPD between the results from both columns is > 100%. **PG** The % difference between the results from both columns is >40% (SW846). **U** Compound analyzed but not detected.

Table 28. Mean (geometric) standard elutriate concentration, Mississippi River background concentrations, available freshwater criteria/standards and dilution ratios for open water disposal in Mississippi River disposal site.

				Federal				US EPA Region 4		State of Louisiana					
		Mississippi River Water Concentration		Primary		Primary & Secondary		Water Quality Screening Values for Hazardous Waste Sites				Minimum Federal or Louisiana Acute Criteria or Standard	Minimum Federal or Louisiana Chronic Criteria or Standard	Dilution Ratios	
Contaminants	Mean (Geometric) Elutriate Concentration	Reported	Assumed	Acute Toxicity Primary Criteria	Chronic Toxicity Primary Criteria	Acute Toxicity Criteria	Chronic Toxicity Criteria	Acute Toxicity Criteria	Chronic Toxicity Criteria	Acute Standards	Chronic Standards			Meeting Acute Criteria	Meeting Chronic Criteria
	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L		
Metals															
Aluminum	450	11.3BJ	11.3	750a	87a	750a	87a	750	87			750	87	0	**5**
Antimony	2.63	0.09B	0.090			180b	30b	1300	160			180	30	0	0
Arsenic	7.12	1.80	1.80	340	150	66c	3.1d	340e	150e	339.8	150	339.8	150	0	0
Barium	748	74.1	74.1			110b	4b					110	4	**18**	**90**
Beryllium	1.73	1U	0.500			35b	0.66b	16	0..53			35	0.660	0	**7**
Cadmium	1.85	1U	0.500	2.0	.25	2.0	.25	2.0	.25	15n	0.62n	2.0	.25	0	**26**
Chromium III	6.75	3.50	3.50	570	74	570	74	570.00	74.00	310n	103n	310	74	0	0
Chromium VI	0.00559	10U	5.00	16	11	16	11	16	11	16	11	16	11	0	0
Copper	5.01	2.1J	2.10	13	9	13	9	13.00	9.00	10n	7n	10	7	0	0
Lead	2.32	0.34BJ	0.340	65	2.5	65	2.5	65.00	2.50	30n	1.2n	30	1.2	0	**1**
Mercury	0.101	0.2U	0.100	1.4	0.77	1.4	0.77	1.4	0.7700	2.04	0.012	1.4	0.012	0	p
Nickel	3.64	1.50	1.50	470	52	470	52	470.00	52.00	788n	88n	470	52	0	0
Selenium	29.1t	0.89B	0.890		5s	20f	5	20g	5.00			20	5	**0.48**	**6**
Silver	2.54	1U	0.500	3.2		3.2	0.36b	3.2	0.012			3.2	0.360	0	**40**
Thallium	0.516	0.031BJ	0.031			110b	12b	140.00	4.00			110	12	0	0
Tin	11.7	1.6B	1.60			2700b	73b					2700	73	0	0
Zinc	11.9	8.70	8.70	120	120	120	120	120.00	120.00	64n	58n	64	58	0	0
Organotins															
Dibutyltin	0.0285	0.037U	0.019											NS	NS
Tributyltin	0.053	0.043U	0.022	0.46h	0.072h	0.46h	0.072h		0.026			0.460	0.072	0	0
Inorganic/General Chemistry															
Ammonia-N	8170	68B	68.0	17000i	1900i							17000	1900	0	**3**
Cyanide	3.81	10U	5.00	22	5.2	22	5.2	22	5.2	45.9	5.4	22	5.2	0	0
PAHs															
2-Methylnaphthalene	0.107	.19U	0.095											NS	NS
Acenaphthene	0.161	.19U	0.095			80f	23f	170	17			80	23	0	0
Acenaphthylene	0.097	.19U	0.095											NS	NS
Anthracene	0.122	.19U	0.095			13b	0.73b					13	0.73	0	0
Benzo(a)anthracene	0.101	.19U	0.095			0.49b	0.027b					0.49	0.027	0	p
Benzo(a)pyrene	0.0980	.19U	0.095			0.24b	0.014b					0.24	0.014	0	p
Benzo(b)fluoranthene	0.0984	.19U	0.095											NS	NS
Benzo(g,h,i)perylene	0.0958	.19U	0.095											NS	NS
Benzo(k)fluoranthene	0.0976	.19U	0.095											NS	NS
Chrysene	0.0969	.19U	0.095											NS	NS
Dibenzo(a,h)anthracene	0.096	.19U	0.095											NS	NS
Dibenzofuran	0.349	.95U	0.475			66b	3.7b					66	3.7	0	0
Fluoranthene	0.124	.19U	0.095			33.6f	6.16f	398	39.8			33.6	6.16	0	0
Fluorene	0.124	.19U	0.095			70b	3.9b					70	3.9	0	0

Contaminants	Mean (Geometric) Elutriate Concentration	Mississippi River Water Concentration		Federal				US EPA Region 4		State of Louisiana		Minimum Federal or Louisiana Acute Criteria or Standard	Minimum Federal or Louisiana Chronic Criteria or Standard	Dilution Ratios	
				Primary		Primary & Secondary		Water Quality Screening Values for Hazardous Waste Sites							
		Reported	Assumed	Acute Toxicity Primary Criteria	Chronic Toxicity Primary Criteria	Acute Toxicity Criteria	Chronic Toxicity Criteria	Acute Toxicity Criteria	Chronic Toxicity Criteria	Acute Standards	Chronic Standards			Meeting Acute Criteria	Meeting Chronic Criteria
	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L		
PAHs (cont.)															
Indeno(1,2,3-c,d)pyrene	0.0977	.19U	0.095											NS	NS
Naphthalene	0.0991	.19U	0.095			190b	12b	230	62			190	12	0	0
Phenanthrene	0.154	.083J	0.083			30f	6.3f					30	6.3	0	0
Pyrene	0.127	.19U	0.095											NS	NS
Semi-Volatile Organic Compounds															
1,4-Dichlorobenzene	0.104	.076J	0.076			180b	15b	112	11.2			180	15	0	0
2,4,6-Trichlorophenol	0.470	.95U	0.475				970f	32	3.2				970	0q	0
2,4-Dichlorophenol	0.0965	.19U	0.095			2020f	365f	202	36.5	202	101	202	101	0	0
2-Chloronaphthalene	0.0965	.19U	0.095			1600f						1600		0	NS
2-Nitrophenol	0.473	.95U	0.475			230f	150f		3500			230	150	0	0
4-Bromophenyl phenyl ether	0.473	.95U	0.475				1.5b						1.5	NS	0
4-Methylphenol (p-Cresol)	0.417	.95U	0.475											NS	NS
4-Nitrophenol	2.39	4.8U	2.40			1200b	300b	828	82.8			1200	300	0	0
Benzoic acid	2.10	4.8U	2.40			740b	42b					740	42	0	0
Benzyl butyl phthalate	0.433	.95U	0.475				19b	330	22				19	0q	0
Bis(2-ethylhexyl) phthalate	0.587	.22J	0.220			27b	3b	1110	<0.3			27	3	0	0
Diethyl phthalate	0.479	.95U	0.475			1800b	210b	5210	521			1800	210	0	0
Di-n-butyl phthalate	0.401	.95U	0.475			190b	35b	94	9.4			190	35	0	0
Di-n-octyl phthalate	0.466	.95U	0.475				708i						708	NS	0
N-Nitrosodiphenylamine	0.101	.19U	0.095			3800b	210b	585	58.5			3800	210	0	0
Pentachlorophenol	0.491	.95U	0.475	19	15	19b	15b	19j	15k			19	15	0	0
Phenol	0.114	.19U	0.095			3600f	110f	1020	256	700	350	700	350	0	0
Chlorinated Pesticides															
4,4'-DDD	0.00300	.00093J PG	0.001			0.19b	0.011b	0.064	0.0064	0.03	0.006	0.03	0.006	0	0
Aldrin	0.00220	.0026U	0.001	3		3		3	0.3	3		3		0	0q
alpha-BHC	0.00150	.0026U	0.001			39b	2.2b		500			39	2.2	0	0
alpha-Chlordane	0.00150	.0026U	0.001	2.4m	0.0043m	2.4m	0.0043m	2.4m	0.0043m			2.4	0.0043	0	0
beta-BHC	0.00210	.0026U	0.001			39b	2.2b		5000			39	2.2	0	0
delta-BHC	0.00370	.0026U	0.001			39b	2.2b					39	2.2	0	0
Dieldrin	0.00180	.0026U	0.001	0.24	0.056	0.24	0.056	0.24	0.0560	0.2374	0.0557	0.2374	0.06	0	0
Endosulfan I	0.00150	.0026U	0.001	0.22	0.056	0.22	0.056	0.22	0.056	0.22	0.0560	0.22	0.06	0	0
Endosulfan II	0.00190	.0026U	0.001	0.22	0.056	0.22	0.056	0.22	0.056			0.22	0.06	0	0
Endosulfan sulfate	0.00280	.0026U	0.001											NS	NS
Endrin	0.00200	.0014J PG N	0.001	0.086	0.036	0.086	0.036	0.086	0.0360	0.0864	0.0375	0.086	0.036	0	0
Endrin aldehyde	0.00170	.0037PG N	0.004											NS	NS
gamma-BHC (Lindane)	0.00290	.0015J PG	0.002	0.95		0.95		0.95	0.08	5.3	0.21	0.95	0.21	0	0
gamma-Chlordane	0.00290	.0025J	0.003	2.4m	0.0043m	2.4m	0.0043m	2.4m	0.0043m			2.4	0.0043	0	0
Heptachlor	0.00290	.0026U	0.001	0.52	0.0038	0.52	0.0038	0.52	0.0038			0.52	0.0038	0	0

Contaminants	Mean (Geometric) Elutriate Concentration	Mississippi River Water Concentration		Federal				US EPA Region 4		State of Louisiana		Minimum Federal or Louisiana Acute Criteria or Standard	Minimum Federal or Louisiana Chronic Criteria or Standard	Dilution Ratios	
				Primary		Primary & Secondary		Water Quality Screening Values for Hazardous Waste Sites							
		Reported	Assumed	Acute Toxicity Primary Criteria	Chronic Toxicity Primary Criteria	Acute Toxicity Criteria	Chronic Toxicity Criteria	Acute Toxicity Criteria	Chronic Toxicity Criteria	Acute Standards	Chronic Standards			Meeting Acute Criteria	Meeting Chronic Criteria
	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L		
Chlorinated Pesticides (cont.)															
Heptachlor epoxide	0.00200	.0026U	0.001	0.52	0.0038	0.52	0.0038	0.52	0.0038			0.52	0.0038	0	0
Methoxychlor	0.00340	.005U	0.003		0.03h		0.03h		0.03				0.030	NS	0
p,p'-DDE (4,4')	0.00200	.0026U	0.001					105	10.5					0q	0q
p,p'-DDT (4,4')	0.00340	.0014J	0.001	1.1	0.001	1.1	0.001	1.1	0.001	1.1	0.001	1.1	0.001	0	**13**
PCB Congeners															
PCB(Aroclor-1016)	0.0105	.02U	0.010					0.2	0.014					0q	0q
PCB(Aroclor-1242)	0.0107	.02U	0.010			1.2b	0.53b	0.2	0.014			1.2	0.53	0	0
PCB(Aroclor-1248)	0.0174	.02U	0.010			1.4b	0.081b	0.2	0.014			1.4	0.081	0	0
PCB(Aroclor-1254)	0.0185	.02U	0.010			0.6b	0.033b	0.2	0.014			0.6	0.033	0	0
PCB(Aroclor-1260)	0.0168	.02U	0.010			1700b	94	0.2	0.014			1700	94	0	0
PCB Total	0.0304	.02U	0.010		0.014	2b	0.014		0.014	2	0.014	2	0.014	0	**4**
													Maximum	**18**	**90**
													Mean	**0.28**	**3**
													Minimum	**0**	**0**

1 NS - No standard

a Non-priority pollutant pH 6.5-9, **b** secondary value, **c** As III 340 µg/L, As V 66 mg/L (secondary value), **d** As III 150 µg/L, As V 3.1 µg/L (secondary value), **e** As III, **f** outdated national ambient water quality standard, **g** the CMC=1/[(f1/CMC1)+(f2/CMC2)] where f1 and f2 are the fractions of total selenium that are treated as selenite and selenate, respectively, and CMC1 and CMC2 are 185.9 µg/L and 12.83 µg/L, respectively, **h** non-priority pollutant, **i** federal EPA criteria for Ammonia, ph 7.6 acute, pH 7.6 and T 26 deg C chronic, **j** at pH 7.8, pH dependent criteria e^(1.005pH-4.83), **k** at pH 7.8, pH dependent criteria e^(1.005pH-5.29), **m** chlordane species not specified, **n** harness dependent criteria, values from Weston IHNC database WQC summary 6 1 2008, **p** assumed background concentration exceeds criteria, elutriate concentration near background concentration, dilution ratio cannot be calculated, **q** based on EPA Region IV screening water quality criteria for hazardous waste sites, , **s** total concentrations, **t** dissolved concentration (total concentrations not measured in SE)

B Compound was detected in the method blank. **J** Compound detected but below the reporting limit (the value given is an estimate). **N** The RPD between the results from both columns is > 100%. **PG** The % difference between the results from both columns is >40% (SW846). **U** Compound analyzed but not detected.

Table 29. Dilution requirements for standard elutriates based on LC50 values from freshwater elutriates.

DMMU	LC50 (% Elutriate)	LOEC (% Elutriate)	NOEC (% Elutriate)	Toxicity Criteria (% Elutriate)	Dilution Ratio For Toxicity Criteria
1 NN	ND	100	50	50	1
2 NN	ND	ND	ND	ND	0
3 NN	ND	ND	ND	ND	0
3 N	ND	ND	ND	ND	0
3 F	ND	10	1*	1	99
4 NN	ND	ND	ND	ND	0
5 NN	ND	ND	ND	ND	0
4/5 N	69	100	50	0.69	144
6 NN	ND	ND	ND	ND	0
6 N	ND	100	50	50	1
6 F	ND	100	50	50	1
7 NN	42	50	10	0.42	237
7 N	72	100	50	0.72	138
7 F	ND	ND	ND	ND	0
8 NN	ND	10	1*	1	99
9 -1 NN	ND	100	50	50	1
9-2&4 NN	ND	ND	ND	ND	0
10 NN	ND	ND	ND	ND	0
10 N	26	50	10	0.26	384
10 F	ND	ND	ND	ND	0

LC50 = median effect concentration. ND = not detected.
LOEC = lowest-observed effects concentration. NOEC = no observed effects concentration.

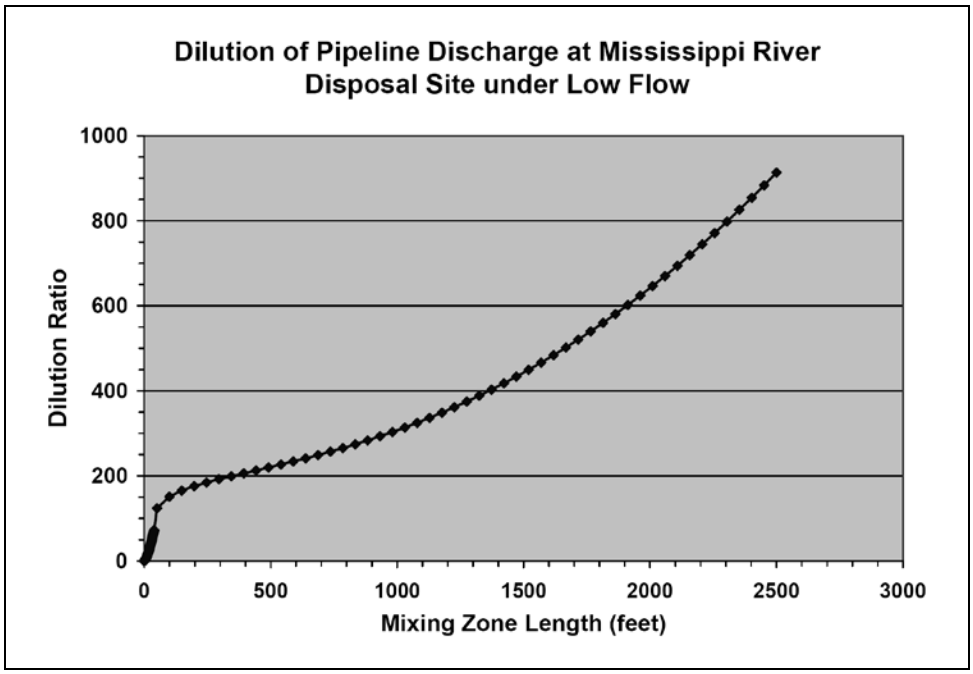

Figure 16. Dilution ratio as a function of distance for pipeline disposal under low flow conditions.

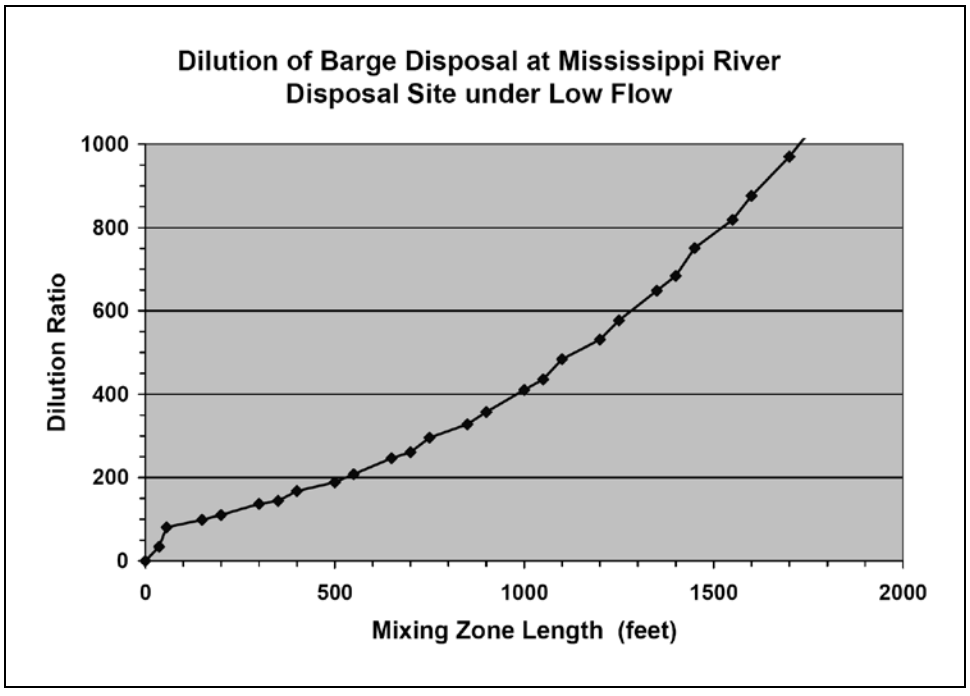

Figure 17. Dilution ratio as a function of distance for barge disposal under low flow conditions.

Discussion

Mixing zone requirements are set forth in Louisiana State Environmental Regulatory Code Part IX, Subpart 1, Chapter 11, §1115C. According to this section, aquatic life criteria apply within the mixing zone, and human health criteria apply only below the point of discharge after complete mixing. Mixing zones are exempted from general and numerical criteria as specified in LAC 33:IX.1113, except as required in paragraph C.5 of this Section. Paragraph C.5 provides narrative criteria pertaining to floating material, substances in concentrations that will produce undesirable or nuisance aquatic life, and materials in concentrations causing acute toxicity to aquatic life. Numerical acute criteria or other acute quantitative limits for toxic substances are applied within the mixing zone, in a zone of initial dilution (ZID) to protect against acute toxicity. Waters outside of the mixing zone must meet all standards for the particular body of water, which requires meeting chronic aquatic life criteria for toxic substances at the edge of the mixing zone. The 7Q10 is specified, limiting 7-day average concentration exceedances (of chronic aquatic life criteria) to no more than once every 10 years. Chloride, sulfate, and total dissolved solids criteria are to be met below the point of discharge after complete mixing (no criteria are provided for these constituents in the LA State Regulatory Code for the IHNC or Bayou Bienvenue).

Limits of mixing zones may include, but are not limited to, linear distances from point source discharges, surface area involvement and volume of receiving water. Nearby mixing zones must be taken into consideration such that overlapping mixing zones do not impair any designated water use in the receiving water body when the water body is considered as a whole.

A list of discharge permits in the vicinity of the MR disposal site was requested from the Louisiana Department of Environmental Quality (DEQ). Businesses and industries discharging into the Mississippi River for the reach 1 mile upstream and downstream of the intersection of the MR and IHNC are listed in Table 30. No discharge permits were found for the Navy shipyard, which is on the east bank of the Mississippi River, where Poland Avenue bends at the river, or for the Alabo Street Wharf, which is just south of the Holy Cross neighborhood. The approximate locations of these and the permitted facilities are shown on a Google earth map (Figure 18). There are also some smaller facilities on the west bank, which may or may not be connected to AEP Elmwood LLC (AEP) and LMS

Ship Management (LMS). They do not appear to have separate discharge permits based on the information provided by DEQ. In addition, there were also a few permits for which no coordinates or other location information was provided. Permit holders for these, which are all storm water discharges, are LADOTD and USACE and are also listed in Table 30. No information was available regarding mixing zone dimensions for these permits, which will be necessary to verify that there is no unacceptable overlap with the proposed mixing zone for the Mississippi River disposal site. Given that disposal has taken place at the Mississippi River disposal site in the past, it seems likely that this is not an issue, but acceptability of the proposed mixing zone will require further confirmation with LA DEQ.

Water intakes must also be considered so that the proposed mixing zone will not adversely impact water quality in these locations. The only drinking water intake that could be found between mile markers 93 and 83 of the Mississippi River (the Inner Harbor Navigation Canal is located at mile marker 92.6) serves the St. Bernard Parish waterworks and is located at 29° 55' 31.046"N, 89° 57' 34.925"W (approximately 4.7 miles below the mouth of the IHNC).[1] This is well beyond the boundaries of the proposed mixing zone for the open water disposal site and should not be impacted by the disposal operation. To verify this, dissolved standard elutriate concentrations were compared to federal primary and secondary drinking water standards and produced a maximum dilution requirement of 120. This dilution ratio is estimated to be met within approximately 50 to 350 ft for all scenarios considered here.

Conclusions

Based on the modeling conducted for disposal in the MR disposal site, a 700-fold dilution could be met within 2100 ft from the discharge point for low flow conditions and within 1000 ft for high flow conditions. This will meet the most stringent dilution requirements based on comparison of elutriate concentrations to water quality criteria and will also satisfy the maximum dilution requirements based on the elutriate toxicity testing. This distance is consistent with the point at which non-detect concentrations have been observed during disposal operations in the past. Also, the dilutions required to be protective based on toxicity can be met within approximately 1400 ft for worst case conditions (low flow, pipeline disposal), as the maximum dilution based on toxicity was less than 400.

[1] Personal Communication. April 2, 2008. Jesse Means, State of Louisiana.

Figure 18. Approximate locations of permitted discharges.

As these mixing zone dimensions appear to be reasonable and consistent with past operation, it appears that none of the materials tested would be excluded from open water disposal on the basis of water column impacts outside of an authorized mixing zone.

Further, evaluation of potential impacts on the St. Bernard Parish water-works inlet indicates that dilution required in order to meet drinking water standards can be achieved within no more than 350 ft from the point of disposal for all scenarios. No information was available to confirm that the proposed mixing zone for the Mississippi River disposal site would not intersect with mixing zones for other permitted discharges. This seems unlikely to be an issue given the long-standing nature of the disposal site, but State criteria require verification that overlap will not result in unacceptable conditions. Without further information regarding mixing zone dimensions for nearby permitted discharges, this remains to be confirmed.

Potential water quality impacts associated with release of effluent and runoff from confined disposal facilities

Objectives

The modified elutriate test is described in Appendix B of the Upland Testing Manual (UTM) (USACE 2003). The modified elutriate is specified for the assessment of water quality impacts associated with release of effluent from confined disposal facilities (CDFs). Effluent discharges are subject to regulation under CWA Section 404. Effluent is nationwide permitted at 33 CFR 330.5(16), which requires that a water quality certification be obtained from the appropriate agency. Typically, a CWA Section 401 Water Quality Certification is obtained from the State.

The UTM also specifies that evaluation of effluent discharges should consider the effects of mixing and dispersion. The Federal regulations implementing Section 404(b)(1), Clean Water Act (40 CFR 230), recognize this and explicitly provide for consideration of mixing in evaluating dredged material releases. Mixing zones are normally defined by the State regulatory agency as part of the CWA Section 401 Water Quality Certification requirements. The State of Louisiana sets forth requirements for mixing zones in LAC 33:IX.1115.C. If water quality standards (WQS) can be met within the prescribed boundaries of an approved mixing zone, there should not be an unacceptable environmental effect as a result of the effluent discharge.

The UTM provides for a tiered evaluation approach similar to those recommended for evaluation of open water disposal in the ITM (USEPA/USACE 1998). Tier I involves assessing existing information to determine environmental pathways and contaminants of concern (COCs). Area land uses, industries, and previous sediment or effluent evaluations would be considered, for example. If information available in Tier I is insufficient to verify that no WQS will be violated outside of an approved mixing zone, Tier II screening is conducted. For Tier II, two screening procedures for estimating effluent contaminant concentrations are presented:

- Total dissolved release of COCs.
- Equilibrium partitioning.

Table 30. Permitted discharges on the Mississippi River near the MR disposal site.

AI	AI Name	Permit No	Permit Type	Issued	Parish	Latitude				Longitude				Phys Address	City	State	Zip Code
						Deg	Min	Sec	Hun	Deg	Min	Sec	Hun				
25619	AEP Elmwood LLC	LA0096512	Indiv-Minor Industrial	01/20/04	Orleans	29	56	36		90	0	52		3700 Patterson Rd	Algiers	LA	70114
12803	Cooper T Smith Stevedoring Co - Mooring Division	LAG480150	Gen-LAG48-Light Commercial	09/05/02	Orleans	29	57	19	11	90	2	36	6	1240 Patterson Dr	Algiers	LA	70114
41181	Crescent Towing Co Inc	LAG532259	Gen-LAG53-Sanitary Class I	02/29/08	Orleans	29	57	18	7	90	2	33	51	1240 Patterson St	Algiers	LA	70114
41181	Crescent Towing Co Inc	LAR05N873	Gen-LAR05-Multi-Sector	07/26/07	Orleans	29	57	18	7	90	2	33	51	1240 Patterson St	Algiers	LA	70114
42267	LMS Ship Management Inc - Algiers Yard	LA0101028	Indiv-Minor Industrial	01/21/04	Orleans	29	57	21		90	2	30		900 Patterson Rd	Algiers	LA	70114
85733	LADOTD - Orleans Parish - LAR100000 Construction Stormwater Activity	LAR10C953	Gen-LAR10-Construction	04/13/05	Orleans									Orleans Parish	Orleans Parish	LA	70000
85733	LADOTD - Orleans Parish - LAR100000 Construction Stormwater Activity	LAR10C990	Gen-LAR10-Construction	05/06/05	Orleans									Orleans Parish	Orleans Parish	LA	70000
85733	LADOTD - Orleans Parish - LAR100000 Construction Stormwater Activity	LAR10D010	Gen-LAR10-Construction	05/16/05	Orleans									Orleans Parish	Orleans Parish	LA	70000
85733	LADOTD - Orleans Parish - LAR100000 Construction Stormwater Activity	LAR10D341	Gen-LAR10-Construction	02/02/06	Orleans									Orleans Parish	Orleans Parish	LA	70000
93683	USArmy COE - Orleans Parish Construction Stormwater Activity	LAR10D546	Gen-LAR10-Construction	06/19/06	Orleans									Orleans Parish	Orleans Parish	LA	70000
93683	USArmy COE - Orleans Parish Construction Stormwater Activity	LAR10E472	Gen-LAR10-Construction	10/09/07	Orleans									Orleans Parish	Orleans Parish	LA	70000
93683	USArmy COE - Orleans Parish Construction Stormwater Activity	LAR10E570	Gen-LAR10-Construction	11/29/07	Orleans									Orleans Parish	Orleans Parish	LA	70000
93683	USArmy COE - Orleans Parish Construction Stormwater Activity	LAR10E609	Gen-LAR10-Construction	12/12/07	Orleans									Orleans Parish	Orleans Parish	LA	70000

The screening procedure based on the assumption of total dissolved release of COCs from sediment was developed for the ITM and is described in more detail in the previous discussion of the standard elutriate results. As previously noted, this procedure is considered to be overly conservative because only a portion of the contaminants associated with sediment will desorb and enter the dissolved phase. Equilibrium partitioning is considered to provide a reasonably conservative estimate of contaminant release from sediment, utilizing accepted conservative partitioning coefficients from adsorption studies to predict dissolved concentrations of contaminants expected in effluent. Predicted concentrations are compared to WQS and exceedances noted. Areas that may require dilution or effluent treatment can be identified and the need for Tier III testing, such as the modified elutriate, can be determined. The list of COCs may also be further refined in some cases. Tier II screening is not a requirement, though it may be helpful in maximizing use of analytical resources. Tier II and Tier III evaluations are normally sufficient for evaluation of effluent discharges. In special cases, Tier IV evaluations (formal risk assessment) may be required to address specific concerns unresolved by Tier II and Tier III evaluations.

In some cases, a definitive determination regarding the acceptability of an effluent discharge cannot be made on the basis of effluent chemistry, as when:

- Criteria are lower than analytical reporting limits.
- There is concern regarding contaminants for which there are no WQS.
- There is concern regarding potential interactive effects of contaminants.

In these cases, Tier III toxicity testing is used to determine dilution requirements. Based on the results of elutriate toxicity testing, an LC50 value is calculated, as previously described in discussion of the standard elutriate results (pages 47 - 49). Where survival is not statistically different from the control, no dilution is required based on toxicity.

In this case, Tier III testing (modified elutriate and water column toxicity tests) was conducted concurrently with sediment evaluations in order to facilitate an accelerated project schedule. As part of the evaluation of effluent discharges from the proposed CDF for the IHNC project, predicted effluent concentrations (based on results of the modified elutriate)

were compared to WQS, and exceedances noted. Dilution required to meet WQS was calculated and properties of the receiving water considered in calculating attainable dilution and required mixing zone dimensions. Toxicity test results were also reviewed and dilution requirements considered for discharge from the CDF into the Gulf Intracoastal Waterway (GIWW) and Bayou Bienvenue.

Data evaluation and dilution requirements

Modified elutriates were analyzed for total and dissolved concentrations. Results obtained for dissolved and total elutriate fractions are summarized here. The raw data are reported elsewhere (Weston Solutions 2008). Effluent toxicity testing was conducted only for standard elutriates, both freshwater and marine.

Because dredging site water largely determines the characteristics of the dredge effluent, elutriate tests are conducted using site water from the dredging site. In this case, some sites that are presently marine in character are expected be freshwater when dredging takes place (once the old lock is opened permanently). This may impact portions of DMMUs 9 and 10 in particular. The importance of this is that the higher ionic strength of saltwater limits the activity of contaminants to some degree, which may in turn result in reduced dissolved concentrations in the elutriate testing. The magnitude of this effect is expected to range from approximately 5 to 20%, based on a preliminary evaluation of Setschenow constants. This is not enough to alter dilution requirements any more than the sediment variability itself, but is mentioned here for completeness.

Water samples were obtained from Bayou Bienvenue and the mitigation site and analyzed by Test America for background concentrations of contaminants of concern (COCs). No water samples were taken from the Gulf Intracoastal Waterway (GIWW) specifically, but samples were taken from DMMU1, which is in close proximity. DMMU 1 water concentrations were therefore used to estimate water quality in the GIWW.

Mean (arithmetic and geometric) and maximum dissolved contaminant concentrations were determined for each constituent, utilizing the modified elutriate results obtained from all DMMUs (Table 31). As for the SE, a value of half the reporting limit (0.5RL) was assumed for all non-detects for calculation of the means. Where the maximum elutriate concentration was less than the corresponding laboratory reporting limit (RL) (the sample was

a non-detect), the highest qualified value reported for the constituent was taken as the maximum. Where the maximum elutriate concentration was less than the RL *and* there were no qualified values (all samples were non-detect), it was assumed the compound was not present and no dilutions were calculated. Where RL was very high, effluent concentrations could be estimated using partitioning analysis. However, it is considered unlikely that these would produce higher dilution requirements than those of contaminants that were present in the elutriate in measurable concentrations. Total concentrations obtained for modified elutriates are summarized in Table 32 and are included for completeness, but none of the applicable criteria are expressed in terms of total concentrations.

Elutriate concentrations (maximum and geometric mean values, for GIWW and Bayou Bienvenue) were compared to applicable water quality criteria in order to determine the need for dilution. Salinity of overlying water was observed to vary from approximately 3 ppt to over 15 ppt in sediment samples taken for column settling tests (Weston Solutions 2008). As a result, it was not clear whether brackish or marine water quality criteria would apply. In order to obtain a conservative estimate of dilution requirements, Federal water quality criteria were therefore compared to both marine and brackish State of Louisiana water quality standards. The lowest of these three values was used to calculate necessary dilutions. For a few constituents no Federal or State criteria were available. In these cases, EPA Region 4 water quality screening criteria for hazardous waste sites were used. Although these are screening values rather than enforceable standards, they were used as part of a “weight of evidence” approach to evaluate potential impacts. Toxicity testing is normally utilized to resolve questions regarding constituents for which there are no criteria. Toxicity tests were not conducted on modified elutriates, however. Dilutions based on the LC50 values obtained for the standard elutriates may be applicable here, although higher mobility of metals would be expected in the modified elutriate. For the SE, no statistically significant toxicity was observed in marine effluent toxicity tests, which would indicate no dilution based on toxicity is required.

Table 31. Modified elutriate results - dissolved fraction.

Component Name	Mean	Geometric Mean	Maximum	Units	MDL	RL	Qualifier	Sample
Group I: Measured values above RL								
2-Methylnaphthalene	0.114	0.102	0.87	µg/L	0.046	0.2		7_9 - F
4,4'-DDD	0.00830	0.00251	0.14	µg/L	0.0019	0.013	PG N	7_2 - NN
4,4'-DDE	0.00480	0.00206	0.069	µg/L	0.0016	0.013	PG	7_2 - NN
4,4'-DDT	0.00159	0.00143	0.0059	µg/L	0.0033	0.013	PG	6_4 - FN
Acenaphthene	0.197	0.141	0.97	µg/L	0.049	0.19		4_6 - NN
Aldrin	0.00190	0.00148	0.014	µg/L	0.00056	0.0026		8_C1_4 - NN
alpha-BHC	0.00144	0.00136	0.0034	µg/L	0.0037	0.013		6_2 - NN
alpha-Chlordane	0.00146	0.00136	0.0047	µg/L	0.0027	0.013	PG	3_C1_3 - F
Aluminum	4114	200	200000	µg/L	6.1	150		10_C3&4 - FN
Ammonia as Nitrogen	6.96	5.71	19.6	mg/L	0.047	0.5		010_C1_6 - NN
Anthracene	0.110	0.104	0.43	µg/L	0.05	0.2		7_2 - NN
Antimony	2.89	2.35	11.2	µg/L	0.24	10		7_2 - NN
Aroclor 1016	0.0755	0.0160	0.84	µg/L	0.048	0.19		7_7_ - F
Aroclor 1248	0.0381	0.0192	0.24	µg/L	0.0045	0.02		8_C1_4 - NN
Aroclor 1254	0.0560	0.0217	0.45	µg/L	0.044	0.19		7_5 - F
Aroclor 1260	0.113	0.0247	1.6	µg/L	0.026	0.19		7_2 - NN
Aroclors (Total)	0.238	0.0387	2.2	µg/L	0.057	0.19		7_2 - NN
Arsenic	7.19	5.92	37.8	µg/L	0.7	5		10_C3&4 - FN
Barium	731	641	1660	µg/L	0.38	50		6_6 - FN
Benzo(a)anthracene	0.0945	0.0920	0.25	µg/L	0.04	0.2		7_2 - NN
Benzo(b)fluoranthene	0.0972	0.0950	0.25	µg/L	0.031	0.2		7_2 - NN
Beryllium	1.91	1.68	9.6	µg/L	0.34	5		10_C3&4 - FN

Component Name	Mean	Geometric Mean	Maximum	Units	MDL	RL	Qualifier	Sample
beta-BHC	0.00310	0.00170	0.03	µg/L	0.0007	0.0025	PG	6_6 - F
Group I: Measured values above RL (cont)								
bis(2-Ethylhexyl) phthalate	0.819	0.524	6.5	µg/L	0.12	0.99		7_9 - F
Calcium	148643	134947	283000	µg/L	31.3	500		6_3 - FN
Chromium	9.90	6.21	216	µg/L	0.56	10		10_C3&4 - FN
Chrysene	0.0946	0.0920	0.23	µg/L	0.035	0.2		7_2 - NN
Copper	8.24	3.09	281	µg/L	0.7	10	J	10_C3&4 - FN
CR, Hexavalent	0.00562	0.00512	0.042	mg/L	0.0026	0.01		10_1 - NN
delta-BHC	0.0153	0.00323	0.28	µg/L	0.00046	0.0025	PG N	5_C1_3 - NN
Dibutyltin	0.0378	0.0221	0.8	µg/L	0.01	0.74		4_4 - NN
Dieldrin	0.00436	0.00190	0.082	µg/L	0.0019	0.013	PG N	7_2 - NN
Dissolved Organic Carbon-DISS	5.68	5.47	9.5	mg/L				010_C1_6 - NN
Endosulfan I	0.00135	0.00127	0.0029	µg/L	0.0018	0.013	PG	6_6 - F
Endosulfan II	0.00321	0.00188	0.039	µg/L	0.0037	0.013	PG N	7_2 - NN
Endosulfan sulfate	0.00349	0.00197	0.047	µg/L	0.0039	0.013		7_2 - NN
Endrin	0.00135	0.00128	0.0027	µg/L	0.0019	0.013	PG	3_C1_3 - F
Endrin aldehyde	0.00220	0.00145	0.037	µg/L	0.0029	0.013	PG N	7_2 - NN
Fluoranthene	0.156	0.122	1.4	µg/L	0.048	0.2		7_2 - NN
Fluorene	0.143	0.119	0.76	µg/L	0.051	0.19		4_5 - NN
gamma-BHC (Lindane)	0.00291	0.00209	0.029	µg/L	0.00074	0.0025	PG N	10_1 - NN
gamma-Chlordane	0.00429	0.00217	0.066	µg/L	0.0018	0.013	PG	7_2 - NN
Heptachlor	0.00226	0.00162	0.025	µg/L	0.00066	0.0025	PG N	6_2 - N
Heptachlor epoxide	0.00268	0.00151	0.041	µg/L	0.0024	0.013	PG N	7_2 - NN
Lead	4.25	1.18	147	µg/L	0.1	5	J	10_C3&4 - FN

Component Name	Mean	Geometric Mean	Maximum	Units	MDL	RL	Qualifier	Sample
Mercury	0.100	0.0979	0.28	µg/L	0.055	0.2		10_C3&4 - FN
Group I: Measured values above RL (cont)								
Methoxychlor	0.00475	0.00301	0.052	µg/L	0.00088	0.0048	PG N	010_C1_6 - NN
Naphthalene	0.102	0.100	0.24	µg/L	0.043	0.2		7_9 - F
Nickel	5.65	3.34	133	µg/L	0.36	5		10_C3&4 - FN
pH-DISS	7.77	7.76	8.50	No Units				10_C3&4 - FN
Phenanthrene	0.156	0.123	0.74	µg/L	0.054	0.2		7_2 - NN
Pyrene	0.144	0.120	1	µg/L	0.055	0.2		7_2 - NN
Selenium	32.5	27.8	61.4	µg/L	1	25	E	010_C1_6 - NN
Total Suspended Solids	719	4.33	40000	mg/L	84	100		10_0C3&4 - F
TPH (as Diesel)	1544	327	27000	µg/L	1900	4000		7_2 - NN
TPH (as Gasoline)	50.0	47.9	160	µg/L	28	100		7_2 - NN
Tributyltin	0.190	0.0352	6.7	µg/L	0.012	0.86		4_4 - NN
Chromium III	9.35	5.28	216	µg/L	0.27	2		10_C3&4 - FN
Zinc	18.7	8.94	522	µg/L	3	25	J	10_C3&4 - FN
Group II: Maximum Value <RL, some qualified values reported								
2,4-DB	1.90	1.86	1.5	µg/L	0.59	4	J	6_3 - FN
2-Chlorophenol	0.485	0.484	0.45	µg/L	0.043	0.94	J	2_C1_6 - NN
Acenaphthylene	0.0963	0.0959	0.05	µg/L	0.043	0.19	J	2_C1_6 - NN
Benzo(a)pyrene	0.0965	0.0958	0.16	µg/L	0.043	0.2	J	7_2 - NN
Benzo(ghi)perylene	0.0952	0.0944	0.052	µg/L	0.027	0.2	J	7_2 - NN
Benzo(k)fluoranthene	0.0965	0.0964	0.1	µg/L	0.039	0.2	J	030C4_6 - N
Benzoic acid	2.40	2.38	0.8	µg/L	0.42	5	J	8_C1_4 - NN
Butyl benzyl phthalate	0.462	0.448	0.2	µg/L	0.14	1	J	5_8 - NN

Component Name	Mean	Geometric Mean	Maximum	Units	MDL	RL	Qualifier	Sample
Cadmium	1.77	1.55	2.1	µg/L	0.53	5	B	10_C3&4 - FN
Group II: Maximum Value <RL, some qualified values reported (cont)								
Cyanide, Total	4.22	4.00	6.6	µg/L	1.7	10	B	6_6 - F
Dalapon	1.04	1.03	1.8	µg/L	0.52	2	J COL	45C2_10 - N
Dibenzofuran	0.431	0.386	0.19	µg/L	0.052	0.98	J	4_C1_3 - NN
Dichlorprop	1.97	1.96	1.2	µg/L	0.72	4	J	6_4 - FN
Diethyl phthalate	0.482	0.481	0.32	µg/L	0.24	0.98	J	7_2 - NN
Di-n-butyl phthalate	0.471	0.457	0.12	µg/L	0.045	0.98	J	7_2 - NN
Di-n-octyl phthalate	0.477	0.468	0.069	µg/L	0.042	0.99	J	030C4_6 - N
Phenol	0.0981	0.0979	0.15	µg/L	0.021	0.19	J	010_C1_6 - NN
Thallium	0.881	0.502	1.9	µg/L	0.09	5	B J	030C1_3 - FN
Tin	11.3	10.9	13.5	µg/L	3.8	25	B J	030C1_3 - FN
Group III: All Samples Non-Detect								
1,2,4-Trichlorobenzene	0.0971	0.0971	0.1	µg/L	0.04	0.2	U	
1,2-Dichlorobenzene	0.0971	0.0971	0.1	µg/L	0.032	0.2	U	
1,2-Diphenylhydrazine	0.0971	0.0971	0.1	µg/L	0.045	0.2	U	
1,3-Dichlorobenzene	0.0971	0.0971	0.1	µg/L	0.037	0.2	U	
1,4-Dichlorobenzene	0.0971	0.0971	0.1	µg/L	0.048	0.2	U	
2,2'-oxybis(1-Chloropropane)	0.0971	0.0971	0.1	µg/L	0.026	0.2	U	
2,4,5-T	0.500	0.500	0.5	µg/L	0.17	1	U	
2,4,5-TP (Silvex)	0.500	0.500	0.5	µg/L	0.16	1	U	
2,4,6-Trichlorophenol	0.485	0.485	0.5	µg/L	0.057	1	U	
2,4-D	2.00	2.00	2	µg/L	1.5	4	U	
2,4-Dichlorophenol	0.0971	0.0971	0.1	µg/L	0.049	0.2	U	

Component Name	Mean	Geometric Mean	Maximum	Units	MDL	RL	Qualifier	Sample
2,4-Dimethylphenol	0.485	0.485	0.5	µg/L	0.052	1	U	
Group III: All Samples Non-Detect (cont)								
2,4-Dinitrophenol	2.43	2.43	2.55	µg/L	1.3	5.1	U	
2,4-Dinitrotoluene	0.485	0.485	0.5	µg/L	0.045	1	U	
2,6-Dinitrotoluene	0.485	0.485	0.5	µg/L	0.051	1	U	
2-Chloronaphthalene	0.0971	0.0971	0.1	µg/L	0.044	0.2	U	
2-Nitrophenol	0.485	0.485	0.5	µg/L	0.054	1	U	
3,3'-Dichlorobenzidine	0.485	0.485	0.5	µg/L	0.041	1	U	
4,6-Dinitro-2-methylphenol	2.43	2.43	2.55	µg/L	1.4	5.1	U	
4-Bromophenyl phenyl ether	0.485	0.485	0.5	µg/L	0.05	1	U	
4-Chloro-3-methylphenol	0.485	0.485	0.5	µg/L	0.059	1	U	
4-Chlorophenyl phenyl ether	0.485	0.485	0.5	µg/L	0.043	1	U	
4-Methylphenol	0.485	0.485	0.5	µg/L	0.074	1	U	
4-Nitrophenol	2.43	2.43	2.55	µg/L	0.072	5.1	U	
Aroclor 1221	0.0205	0.0129	0.095	µg/L	0.048	0.19	U	
Aroclor 1232	0.0205	0.0129	0.095	µg/L	0.057	0.19	U	
Aroclor 1242	0.0205	0.0129	0.095	µg/L	0.036	0.19	U	
Benzidine	9.71	9.71	10	µg/L	5.6	20	U	
bis(2-Chloroethoxy)methane	0.485	0.485	0.5	µg/L	0.12	1	U	
bis(2-Chloroethyl) ether	0.0971	0.0971	0.1	µg/L	0.046	0.2	U	
Chlordane (technical)	0.0129	0.0124	0.06	µg/L	0.036	0.12	U	
Diazinon	0.482	0.482	0.5	µg/L	0.12	1	U	
Dibenz(a,h)anthracene	0.0971	0.0971	0.1	µg/L	0.035	0.2	U	
Dicamba	1.00	1.00	1	µg/L	0.33	2	U	

Component Name	Mean	Geometric Mean	Maximum	Units	MDL	RL	Qualifier	Sample
Dimethyl phthalate	0.485	0.485	0.5	µg/L	0.042	1	U	
Group III: All Samples Non-Detect (cont)								
Dinoseb	0.300	0.300	0.3	µg/L	0.26	0.6	U	
Hexachlorobenzene	0.0971	0.0971	0.1	µg/L	0.043	0.2	U	
Hexachlorobutadiene	0.0971	0.0971	0.1	µg/L	0.038	0.2	U	
Hexachlorocyclopentadiene	0.485	0.485	0.5	µg/L	0.08	1	U	
Hexachloroethane	0.485	0.485	0.5	µg/L	0.043	1	U	
Indeno(1,2,3-cd)pyrene	0.0971	0.0971	0.1	µg/L	0.048	0.2	U	
Isophorone	0.485	0.485	0.5	µg/L	0.047	1	U	
MCPA	200	200	200	µg/L	94	400	U	
MCPP	200	200	200	µg/L	130	400	U	
Monobutyltin	0.336	0.261	4.8	µg/L	0.05	9.6	U	
Nitrobenzene	0.0971	0.0971	0.1	µg/L	0.064	0.2	U	
N-Nitrosodimethylamine	0.485	0.485	0.5	µg/L	0.045	1	U	
N-Nitrosodi-n-propylamine	0.0971	0.0971	0.1	µg/L	0.059	0.2	U	
N-Nitrosodiphenylamine	0.0971	0.0971	0.1	µg/L	0.049	0.2	U	
Pentachlorophenol	0.485	0.485	0.5	µg/L	0.083	1	U	
Silver	2.50	2.50	2.50	µg/L	0.39	5	U	
Tetrabutyltin	0.0333	0.0264	0.48	µg/L	0.0086	0.96	U	
Toxaphene	0.00135	0.00129	0.0065	µg/L	0.0037	0.013	U	

COL The RPD between the results from both columns is > 40%, the lower of the two results is reported. E Compound was over the calibration range. J Compound detected but below the reporting limit (the value given is an estimate). N The RPD between the results from both columns is > 100%. PG The % difference between the results from both columns is >40% (SW846). U Compound analyzed but not detected.

Table 32. Modified elutriate results - total fraction.

Component Name	Mean	Geometric Mean	Maximum	Units	MDL	RL	Qualifier	Sample
Group I: Measured values above RL								
2-Methylnaphthalene	0.151	0.116	1.3	µg/L	0.045	0.19		7_9 - F
4,4'-DDD	0.0348	0.0142	0.26	µg/L	0.019	0.13	PG N	7_2 - NN
4,4'-DDT	0.0293	0.00813	0.23	µg/L	0.0067	0.025	PG	5_6 - NN
Acenaphthene	0.376	0.194	2.5	µg/L	0.052	0.2		9_1 - NN
Acenaphthylene	0.108	0.104	0.34	µg/L	0.05	0.22		2_C1_6 - NN
Aluminum	770179	619615	2310000	µg/L	60.6	1500		2_C1_6 - NN
Ammonia as Nitrogen	12.6	10.2	44.2	mg/L	0.094	1	J	4_C1_3 - NN
Anthracene	0.227	0.145	2.1	µg/L	0.051	0.2		4_6 - NN
Antimony	6.04	3.12	55.4	µg/L	0.47	20		4_6 - NN
Aroclor 1016	0.198	0.0174	2.7	µg/L	0.048	0.19		7_8 - F
Aroclor 1248	0.0805	0.0263	0.83	µg/L	0.0044	0.019		4_4 - NN
Aroclor 1254	0.238	0.0388	2.7	µg/L	0.044	0.19		7_3 - NN
Aroclor 1260	0.505	0.0522	7.8	µg/L	0.027	0.2		7_2 - NN
Aroclors (Total)	0.983	0.0863	8.1	µg/L	0.056	0.19		7_3 - NN
Arsenic	288	239	902	µg/L	0.7	5		7_4 - NN
Barium	13858	6518	172000	µg/L	3.8	500	E	010_C1_6 - NN
Benzo(a)anthracene	0.241	0.148	1.6	µg/L	0.039	0.19		7_4 - NN
Benzo(a)pyrene	0.240	0.140	2	µg/L	0.041	0.19		7_4 - NN
Benzo(b)fluoranthene	0.293	0.152	2.9	µg/L	0.029	0.19		7_4 - NN
Benzo(ghi)perylene	0.193	0.131	1.4	µg/L	0.026	0.19		7_4 - NN
Benzo(k)fluoranthene	0.162	0.122	1.1	µg/L	0.037	0.19		7_4 - NN

Component Name	Mean	Geometric Mean	Maximum	Units	MDL	RL	Qualifier	Sample
Group I: Measured values above RL (cont)								
Beryllium	43.7	36.4	121	µg/L	0.34	5		7_4 - NN
bis(2-Ethylhexyl) phthalate	1.49	0.754	26	µg/L	0.12	0.99		7_7_ - F
Butyl benzyl phthalate	0.438	0.395	1.6	µg/L	0.14	0.99		7_7_ - F
Cadmium	28.3	21.5	97.2	µg/L	0.53	5		7_4 - NN
Calcium	539268	512555	967000	µg/L	313	5000		2_C1_6 - NN
Chromium	1052	819	3530	µg/L	0.56	10		7_4 - NN
Chrysene	0.267	0.151	2.1	µg/L	0.033	0.19		7_4 - NN
Copper	1404	983	6640	µg/L	1.4	20		4_4 - NN
Cyanide, Total	16.3	6.75	224	µg/L	17	100		7_2 - NN
Dibenz(a,h)anthracene	0.103	0.101	0.31	µg/L	0.035	0.2		4_C1_3 - NN
Dibutyltin	0.788	0.217	6.6	µg/L	0.01	0.77		4_C1_3 - NN
Dieldrin	0.012	0.00402	0.2	µg/L	0.02	0.13	PG N	7_2 - NN
Endosulfan II	0.0137	0.00648	0.15	µg/L	0.0038	0.013	PG N	6_4 - FN
Endosulfan sulfate	0.0233	0.00635	0.42	µg/L	0.039	0.13	PG N	7_2 - NN
Endrin aldehyde	0.00814	0.00335	0.067	µg/L	0.0029	0.012		030C1_3 - FN
Fluoranthene	0.562	0.211	4.1	µg/L	0.047	0.19		7_4 - NN
Fluorene	0.280	0.164	2.2	µg/L	0.054	0.2		4_6 - NN
gamma-Chlordane	0.0132	0.00512	0.15	µg/L	0.0037	0.025	PG	5_6 - NN
Heptachlor epoxide	0.00826	0.00332	0.1	µg/L	0.0048	0.025	PG N	5_6 - NN
Indeno(1,2,3-cd)pyrene	0.176	0.126	1.3	µg/L	0.045	0.19		7_4 - NN
Lead	2027	1102	13300	µg/L	0.1	5	J	7_4 - NN
Mercury	6.67	3.53	45.5	µg/L	0.55	2		5_6 - NN

Component Name	Mean	Geometric Mean	Maximum	Units	MDL	RL	Qualifier	Sample
Group I: Measured values above RL (cont)								
Methoxychlor	0.0143	0.00670	0.13	µg/L	0.0009	0.0049	PG N	8_C1_4 - NN
Naphthalene	0.133	0.115	0.89	µg/L	0.042	0.19		6_6 - FN
Nickel	980	821	2920	µg/L	0.36	5		7_4 - NN
N-Nitrosodiphenylamine	0.134	0.104	2.1	µg/L	0.046	0.19		7_4 - NN
pH	7.81	7.81	8.5	No Units				10_C3&4 - FN
Phenanthrene	0.499	0.215	3.7	µg/L	0.055	0.2		4_6 - NN
Pyrene	0.520	0.205	4.4	µg/L	0.053	0.19		7_4 - NN
Silver	6.78	3.85	36.1	µg/L	0.39	5		7_4 - NN
Tin	74.9	44.4	370	µg/L	37.9	250		10_C1_6 - NN
Total Organic Carbon	13.0	10.5	42	mg/L				8_C1_4 - NN
Total Suspended Solids	45053	36554	118000	mg/L	3.4	200		10_C1_6 - NN
TPH (as Diesel)	1941	679	24000	µg/L	940	3700	B	5_6 - NN
TPH (as Gasoline)	46.6	43.9	160	µg/L	28	100		2_C1_6 - NN
Tributyltin	3.59	0.309	120	µg/L	0.012	15		4_4 - NN
Chromium III	1023	634	3530	µg/L	0.27	2		7_4 - NN
Zinc	5487	3545	27400	µg/L	3	25	J	7_4 - NN
Group II: Maximum Value <RL, some qualified values reported								
2-Chlorophenol	0.489	0.489	0.4	µg/L	0.049	1.1	J	2_C1_6 - NN
4-Methylphenol	0.486	0.482	0.16	µg/L	0.071	0.97	J	7_9 - F
Aldrin	0.00645	0.00332	0.023	µg/L	0.00054	0.0025	PG	8_C1_4 - NN
alpha-BHC	0.00594	0.00297	0.0081	µg/L	0.0036	0.012	J	6_5 - F
alpha-Chlordane	0.00643	0.00323	0.022	µg/L	0.00055	0.0025	PG N	4_8 - NN

Component Name	Mean	Geometric Mean	Maximum	Units	MDL	RL	Qualifier	Sample
Group II: Maximum Value <RL, some qualified values reported (cont)								
Benzoic acid	2.42	2.39	0.52	µg/L	0.42	5	J	5_C1_3 - NN
beta-BHC	0.00605	0.00306	0.0094	µg/L	0.0007	0.0025	PG N	6_2 - N
delta-BHC	0.00992	0.00485	0.058	µg/L	0.0023	0.013	PG N	5_4 - NN
Diethyl phthalate	0.488	0.486	0.27	µg/L	0.24	1	J	3_C4_6 - NN
Di-n-butyl phthalate	0.369	0.300	0.23	µg/L	0.046	1	J	3_C4_6 - NN
Di-n-octyl phthalate	0.484	0.474	0.064	µg/L	0.043	1	J	9_C2&4 - NN
Endosulfan I	0.00616	0.00310	0.015	µg/L	0.00036	0.0025		8_C1_4 - NN
Endrin	0.00751	0.00344	0.045	µg/L	0.0019	0.013	PG	6_6 - FN
Heptachlor	0.00619	0.00313	0.016	µg/L	0.00068	0.0025	PG	8_C1_4 - NN
2,4-DB	1.99	1.97	2.7	µg/L	0.59	4	J PG	7_4 - NN
4,4'-DDE	0.0143	0.01	0.13	µg/L	0.017	0.13	PG N	7_2 - NN
CR, Hexavalent	2.33	2.14	5	mg/L	1.3	5	U G	7_4 - NN
Dalapon	0.997	0.992	1.3	µg/L	0.52	2	J COL	4/5_8 - N
Dibenzofuran	0.408	0.342	0.8	µg/L	0.053	1	J	5_C1_3 - NN
gamma-BHC (Lindane)	0.00731	0.00405	0.07	µg/L	0.036	0.13	J PG	7_3 - NN
Percent Solids	61.2	60.4	78.6	%	0			3_C1_3 - F
Selenium	71.8	63.2	232	µg/L	10.3	250	B J	2_C1_6 - NN
Thallium	11.8	9.54	38.4	µg/L	0.9	50	B J	10_C1_6 - NN
Group III: All Samples Non-Detect								
1,2,4-Trichlorobenzene	0.0985	0.0984	0.11	µg/L	0.043	0.22	U	8_C1_4 - NN
1,2-Dichlorobenzene	0.0985	0.0984	0.11	µg/L	0.034	0.22	U	8_C1_4 - NN
1,2-Diphenylhydrazine	0.0985	0.0984	0.11	µg/L	0.048	0.22	U	8_C1_4 - NN

Component Name	Mean	Geometric Mean	Maximum	Units	MDL	RL	Qualifier	Sample
Group III: All Samples Non-Detect (cont)								
1,3-Dichlorobenzene	0.0985	0.0984	0.11	µg/L	0.04	0.22	U	8_C1_4 - NN
1,4-Dichlorobenzene	0.0985	0.0984	0.11	µg/L	0.052	0.22	U	8_C1_4 - NN
2,2'-oxybis(1-Chloropropane)	0.0985	0.0984	0.11	µg/L	0.028	0.22	U	8_C1_4 - NN
2,4,5-T	0.500	0.500	0.5	µg/L	0.17	1	U	45C2_10 - N
2,4,5-TP (Silvex)	0.500	0.500	0.5	µg/L	0.16	1	U	45C2_10 - N
2,4,6-Trichlorophenol	0.492	0.491	0.55	µg/L	0.061	1.1	U	8_C1_4 - NN
2,4-D	2.00	2.00	2	µg/L	1.5	4	U	45C2_10 - N
2,4-Dichlorophenol	0.0985	0.0984	0.11	µg/L	0.052	0.22	U	8_C1_4 - NN
2,4-Dimethylphenol	0.492	0.491	0.55	µg/L	0.056	1.1	U	8_C1_4 - NN
2,4-Dinitrophenol	2.46	2.46	2.7	µg/L	1.4	5.4	U	8_C1_4 - NN
2,4-Dinitrotoluene	0.492	0.491	0.55	µg/L	0.049	1.1	U	8_C1_4 - NN
2,6-Dinitrotoluene	0.492	0.491	0.55	µg/L	0.055	1.1	U	8_C1_4 - NN
2-Chloronaphthalene	0.0985	0.0984	0.11	µg/L	0.048	0.22	U	8_C1_4 - NN
2-Nitrophenol	0.492	0.491	0.55	µg/L	0.058	1.1	U	8_C1_4 - NN
3,3'-Dichlorobenzidine	0.492	0.491	0.55	µg/L	0.044	1.1	U	8_C1_4 - NN
4,6-Dinitro-2-methylphenol	2.46	2.46	2.7	µg/L	1.5	5.4	U	8_C1_4 - NN
4-Bromophenyl phenyl ether	0.492	0.491	0.55	µg/L	0.054	1.1	U	8_C1_4 - NN
4-Chloro-3-methylphenol	0.492	0.491	0.55	µg/L	0.064	1.1	U	8_C1_4 - NN
4-Chlorophenyl phenyl ether	0.492	0.491	0.55	µg/L	0.046	1.1	U	8_C1_4 - NN
4-Nitrophenol	2.46	2.46	2.7	µg/L	0.076	5.4	U	8_C1_4 - NN
Aroclor 1221	0.0205	0.0129	0.1	µg/L	0.049	0.2	U	7_7_ - F
Aroclor 1232	0.0205	0.0129	0.1	µg/L	0.058	0.2	U	7_7_ - F

Component Name	Mean	Geometric Mean	Maximum	Units	MDL	RL	Qualifier	Sample
Group III: All Samples Non-Detect (cont)								
Aroclor 1242	0.0205	0.0129	0.1	µg/L	0.037	0.2	U	7_7_ - F
Benzidine	9.85	9.84	11	µg/L	6.1	22	U	8_C1_4 - NN
bis(2-Chloroethoxy)methane	0.492	0.491	0.55	µg/L	0.13	1.1	U	8_C1_4 - NN
bis(2-Chloroethyl) ether	0.0985	0.0984	0.11	µg/L	0.05	0.22	U	8_C1_4 - NN
Chlordane (technical)	0.0557	0.0283	0.6	µg/L	0.36	1.2	U	7_3 - NN
Diazinon	1.07	0.790	2.5	µg/L	0.58	5	U	7_4 - NN
Dicamba	1.00	1.00	1	µg/L	0.33	2	U	45C2_10 - N
Dichlorprop	2.00	2.00	2	µg/L	0.72	4	U	45C2_10 - N
Dimethyl phthalate	0.492	0.491	0.55	µg/L	0.046	1.1	U	8_C1_4 - NN
Dinoseb	0.300	0.300	0.3	µg/L	0.26	0.6	U	45C2_10 - N
Hexachlorobenzene	0.0985	0.0984	0.11	µg/L	0.047	0.22	U	8_C1_4 - NN
Hexachlorobutadiene	0.0985	0.0984	0.11	µg/L	0.041	0.22	U	8_C1_4 - NN
Hexachlorocyclopentadiene	0.492	0.491	0.55	µg/L	0.086	1.1	U	8_C1_4 - NN
Hexachloroethane	0.492	0.491	0.55	µg/L	0.047	1.1	U	8_C1_4 - NN
Isophorone	0.492	0.491	0.55	µg/L	0.051	1.1	U	8_C1_4 - NN
MCPA	200	200	200	µg/L	94	400	U	45C2_10 - N
MCPP	200	200	200	µg/L	130	400	U	45C2_10 - N
Monobutyltin	3.12	1.34	85	µg/L	0.05	170	U	4_4 - NN
Nitrobenzene	0.0985	0.0984	0.11	µg/L	0.069	0.22	U	8_C1_4 - NN
N-Nitrosodimethylamine	0.492	0.491	0.55	µg/L	0.049	1.1	U	8_C1_4 - NN
N-Nitrosodi-n-propylamine	0.0985	0.0984	0.11	µg/L	0.064	0.22	U	8_C1_4 - NN
Pentachlorophenol	0.492	0.491	0.55	µg/L	0.09	1.1	U	8_C1_4 - NN

Component Name	Mean	Geometric Mean	Maximum	Units	MDL	RL	Qualifier	Sample
Phenol	0.0985	0.0984	0.11	µg/L	0.024	0.22	U	8_C1_4 - NN
Tetrabutyltin	0.312	0.134	8.5	µg/L	0.0086	17	U	4_4 - NN
Toxaphene	0.00591	0.00296	0.065	µg/L	0.036	0.13	U	7_3 - NN

B Compound was detected in the method blank. COL The RPD between the results from both columns is > 40%, the lower of the two results is reported. E Compound was over the calibration range. J Compound detected but below the reporting limit (the value given is an estimate). N The RPD between the results from both columns is > 100%. PG The % difference between the results from both columns is >40% (SW846). U Compound analyzed but not detected.

Comparison of contaminant concentrations in modified elutriates and standard elutriates indicates they are generally comparable and in no case were metals higher in modified elutriates than in SE. The toxicity testing conducted on the standard elutriates is therefore considered to be reasonably representative for determination of dilution requirements for modified elutriates where standards are not available.

Where elutriate concentrations exceeded either acute or chronic water quality standards, dilutions were calculated using background concentrations of the receiving waters. Where background concentrations exceeded the standard, dilution was calculated to 10% above background. Where background exceeded the elutriate concentrations, no dilution could be calculated.

Runoff concentrations are normally considered as part of the mixing zone analysis. Predicted runoff concentrations are compared to acute criteria rather than chronic, due to the short-term and intermittent nature of discharges. Suspended solids concentrations are also lower in runoff as compared to effluent. Dilution requirements for runoff discharges are therefore typically much less than that required for the effluent pathway and can be estimated conservatively based on elutriate concentrations for the unoxidized case (dredged material surface is wet). Metals mobility typically increases as material dries and oxidizes, however, and the simplified laboratory runoff procedure (SLRP) test is used to model this (Price and Skogerboe 2000). Runoff concentrations and dilution requirements for the oxidized case will therefore require consideration of the SLRP test results. A review and update of the preliminary pathway analysis, including analysis of the SLRP results, are planned when ongoing data acquisition efforts are completed for the disposal site.

The analytical data were subjected to a rigorous data validation process (Weston Solutions 2008). Data validation normally involves verifying quality control parameters imbedded in the data such as surrogate recovery and evaluating such things as instrument calibration ranges and other factors potentially impacting the reliability of the results. If any quality control parameters are found to fall outside accepted ranges, and no corrective action can be taken, the data may be rejected. Six modified elutriate samples (dissolved concentrations) were rejected in the data validation, and these data points were removed from the database before dilutions were calculated. Affected samples and compounds are summa-

rized in Table 33. Modified elutriate from DMMU 10 sample C3&4-F was rejected for 100 different compounds. Two were metals (hexavalent chromium and Monobutyltin), and the remainder was organic compounds. Monobutyltin was affected for five samples, and endrin aldehyde was affect for two samples. The remainder of the affected compounds were associated with the modified elutriate from DMMU 10 sample C3&4 - F.

Six elutriate samples (total concentrations) were rejected for three compounds. These samples and compounds are also listed in Table 33.

GIWW dilution requirements

For discharge to the GIWW, a maximum dilution of 770 (copper, DMMU 10 sample C3&4 - N) was required to meet marine acute criteria, and a maximum dilution of 3179 (tributyltin, DMMU 4 sample 4 - NN) was required to meet marine chronic criteria (Table 34). However, DMMU 10 sample C3&4 - N results were two orders of magnitude higher than all the other samples and an order of magnitude higher than the next highest sample, which was DMMU 10 sample C3&4 - F. For both composites from DMMU 10, sediment concentrations were not correspondingly elevated. For DMMU 10 sample C3&4 - F, extremely high TSS concentrations (40,000 mg/L) were reported. Maximum dilution based on the highest reliable sample concentration (DMMU 4 sample 5 - NN) resulted in a dilution ratio of 8 to meet acute (and chronic) criteria for copper.

Lead dilution requirements were also relatively high to meet chronic criteria (197), but again the maximum elutriate concentration was associated with DMMU 10 sample 3C&4 - N, which was two orders of magnitude higher than all other samples except DMMU 10 sample 3C&4 - F. As for copper, sediment concentrations for these composites were not elevated suggesting analytical error in the elutriate results. Substitution of the highest reliable elutriate concentration for lead (DMMU 4/5 sample 8 - N) results in a dilution ratio of 8 to meet marine chronic criteria (and 0 to meet acute criteria).

Maximum overall dilution remains at 3179 for marine chronic criteria, due to the high concentration of tributyltin in the modified elutriate of DMMU 4 sample 4 - NN. For that sample, tributyltin sediment concentrations were the highest of all sediments tested, pH was in the same range as the other samples, and TSS were among the lowest, suggesting that the elevated elutriate concentrations are real. Activated carbon may be

effective in reducing tributyltin concentrations in the effluent prior to discharge, thus reducing dilution requirements for this contaminant substantially. Bench testing will be required to evaluate effectiveness and determine needed carbon dosage.

Dilutions based on mean (geometric mean) elutriate concentrations (Table 35) indicated all marine acute criteria were met without mixing, and a maximum dilution of 6 was required to meet marine chronic criteria.

No toxicity testing was conducted on modified elutriates for determination of dilution requirements for constituents lacking WQC. Modified elutriate concentrations were therefore compared to standard elutriate concentrations to evaluate applicability of standard elutriate toxicity tests in determining modified elutriate dilution requirements. There were no metals for which any concentrations were higher in the modified elutriates (mean, geometric mean or maximum), and for the few organic constituents that were higher, the maximum was only 14% higher than the standard elutriates concentration. Standard elutriates toxicity tests are therefore thought to be reasonably representative of toxicity that would be expected with modified elutriates. Survival was not statistically different from control in toxicity testing conducted on marine standard elutriates, and no LC50 values resulted. Therefore, no dilution of effluent is considered necessary for discharge in the marine environment based on toxicity.

Bayou Bienvenue dilution requirements

For discharge to Bayou Bienvenue, a maximum dilution of 226, for copper, was required to meet marine acute criteria (DMMU 10 sample C3&4 - N), and a maximum dilution of 3105, for tributyltin, was required to meet marine chronic criteria (DMMU 4 sample 4 - NN) (Table 34).

However, DMMU 10 sample C3&4 - N results are considered unreliable, as previously discussed. Maximum dilution based on the highest reliable sample concentration (DMMU 4 sample 5 NN) resulted in a dilution ratio of 2.6 to meet acute criteria for copper (5.3 for chronic). Lead dilution requirements were also relatively high to meet chronic criteria (180), but again the maximum elutriate concentration was associated with DMMU 10 Composite 3&4N. Substitution of the highest reliable elutriate concentration for lead (DMMU 4/5 sample 8 - N) results in a dilution ratio of 7 to meet marine chronic criteria (0 to meet acute). Maximum overall dilution

Table 33. Modified elutriate data validation rejects.

Sample ID	Compound	Sample ID	Compound
10_ C3&4 - F	1,2,4-Trichlorobenzene-DISS	3_C4_6 - NN	Chromium, hexavalent-Total
10_ C3&4 - F	1,2-Dichlorobenzene-DISS	4_4 - NN	Chromium, hexavalent-Total
10_ C3&4 - F	1,2-Diphenylhydrazine-DISS	4_6 - NN	Chromium, hexavalent-Total
10_ C3&4 - F	1,3-Dichlorobenzene-DISS	10_ C3&4 - F	Chrysene-DISS
10_ C3&4 - F	1,4-Dichlorobenzene-DISS	10_ C3&4 - F	Dalapon-DISS
10_ C3&4 - F	2,2'-oxybis(1-Chloropropane)-DISS	10_ C3&4 - F	delta-BHC-DISS
10_ C3&4 - F	2,4,5-T-DISS	10_ C3&4 - F	Diazinon-DISS
10_ C3&4 - F	2,4,5-TP (Silvex)-DISS	10_ C3&4 - F	Dibenz(a,h)anthracene-DISS
10_ C3&4 - F	2,4,6-Trichlorophenol-DISS	10_ C3&4 - F	Dibenzofuran-DISS
10_ C3&4 - F	2,4-DB-DISS	10_ C3&4 - F	Dicamba-DISS
10_ C3&4 - F	2,4-D-DISS	10_ C3&4 - F	Dichlorprop-DISS
10_ C3&4 - F	2,4-Dichlorophenol-DISS	10_ C3&4 - F	Dieldrin-DISS
10_ C3&4 - F	2,4-Dimethylphenol-DISS	10_ C3&4 - F	Diethyl phthalate-DISS
10_ C3&4 - F	2,4-Dinitrophenol-DISS	10_ C3&4 - F	Dimethyl phthalate-DISS
10_ C3&4 - F	2,4-Dinitrotoluene-DISS	10_ C3&4 - F	Di-n-butyl phthalate-DISS
10_ C3&4 - F	2,6-Dinitrotoluene-DISS	10_ C3&4 - F	Di-n-octyl phthalate-DISS
10_ C3&4 - F	2-Chloronaphthalene-DISS	10_ C3&4 - F	Dinoseb-DISS
10_ C3&4 - F	2-Chlorophenol-DISS	010_C1_6 - NN	Dinoseb-Total
10_ C3&4 - F	2-Methylnaphthalene-DISS	10_ C3&4 - F	Endosulfan I-DISS
10_ C3&4 - F	2-Nitrophenol-DISS	10_ C3&4 - F	Endosulfan II-DISS
10_ C3&4 - F	3,3'-Dichlorobenzidine-DISS	10_ C3&4 - F	Endosulfan sulfate-DISS
10_ C3&4 - F	4,4'-DDE-DISS	10_1 - NN	Endrin aldehyde-DISS
10_ C3&4 - F	4,4'-DDT-DISS	10_ C3&4 - F	Endrin aldehyde-DISS
10_ C3&4 - F	4,6-Dinitro-2-methylphenol-DISS	10_ C3&4 - F	Endrin-DISS
10_ C3&4 - F	4-Bromophenyl phenyl ether-DISS	10_ C3&4 - F	Fluoranthene-DISS
10_ C3&4 - F	4-Chloro-3-methylphenol-DISS	10_ C3&4 - F	Fluorene-DISS
10_ C3&4 - F	4-Chlorophenyl phenyl ether-DISS	10_ C3&4 - F	gamma-Chlordane-DISS
10_ C3&4 - F	4-Methylphenol-DISS	10_ C3&4 - F	Heptachlor epoxide-DISS
10_ C3&4 - F	4-Nitrophenol-DISS	10_ C3&4 - F	Heptachlor-DISS
10_ C3&4 - F	Acenaphthene-DISS	10_ C3&4 - F	Hexachlorobenzene-DISS
10_ C3&4 - F	Acenaphthylene-DISS	10_ C3&4 - F	Hexachlorobutadiene-DISS
10_ C3&4 - F	Aldrin-DISS	10_ C3&4 - F	Hexachlorocyclopentadiene-DISS
10_ C3&4 - F	alpha-BHC-DISS	10_ C3&4 - F	Hexachloroethane-DISS
10_ C3&4 - F	alpha-Chlordane-DISS	10_ C3&4 - F	Indeno(1,2,3-cd)pyrene-DISS
10_ C3&4 - F	Anthracene-DISS	10_ C3&4 - F	Isophorone-DISS

Sample ID	Compound	Sample ID	Compound
10_ C3&4 - F	Aroclor 1016-DISS	10_ C3&4 - F	MCPA-DISS
10_ C3&4 - F	Aroclor 1221-DISS	10_ C3&4 - F	MCPP-DISS
10_ C3&4 - F	Aroclor 1232-DISS	10_ C3&4 - F	Methoxychlor-DISS
10_ C3&4 - F	Aroclor 1242-DISS	4_5 - NN	Monobutyltin
10_ C3&4 - F	Aroclor 1248-DISS	4_7_ - NN	Monobutyltin
10_ C3&4 - F	Aroclor 1254-DISS	7_4 - NN	Monobutyltin
10_ C3&4 - F	Aroclor 1260-DISS	10_ C3&4 - F	Monobutyltin
10_ C3&4 - F	Aroclors (Total)-DISS	10_C3&4 - N	Monobutyltin
10_ C3&4 - F	Benzidine-DISS	07_C1_9 - N	Monobutyltin – Total
10_ C3&4 - F	Benzo(a)anthracene-DISS	10_1 - NN	Monobutyltin – Total
10_ C3&4 - F	Benzo(a)pyrene-DISS	10_ C3&4 - F	Naphthalene-DISS
10_ C3&4 - F	Benzo(b)fluoranthene-DISS	10_ C3&4 - F	Nitrobenzene-DISS
10_ C3&4 - F	Benzo(ghi)perylene-DISS	10_ C3&4 - F	N-Nitrosodimethylamine-DISS
10_ C3&4 - F	Benzo(k)fluoranthene-DISS	10_ C3&4 - F	N-Nitrosodi-n-propylamine-DISS
10_ C3&4 - F	Benzoic acid-DISS	10_ C3&4 - F	N-Nitrosodiphenylamine-DISS
10_ C3&4 - F	beta-BHC-DISS	10_ C3&4 - F	Pentachlorophenol-DISS
10_ C3&4 - F	bis(2-Chloroethoxy)methane-DISS	10_ C3&4 - F	Phenanthrene-DISS
10_ C3&4 - F	bis(2-Chloroethyl) ether-DISS	10_ C3&4 - F	Phenol-DISS
10_ C3&4 - F	Butyl benzyl phthalate-DISS	10_ C3&4 - F	Pyrene-DISS
10_ C3&4 - F	Chlordane (technical)-DISS	10_ C3&4 - F	Toxaphene-DISS
10_ C3&4 - F	Chromium, hexavalent-DISS		

remains at 3105 for marine chronic, due to the high concentration of tributyltin in DMMU 4 sample 4 - NN.

Dilutions based on mean (geometric mean) elutriate concentrations (Table 35) indicated all marine acute criteria were met without mixing, and a maximum dilution of 8 was required to meet marine chronic criteria.

Mixing

GIWW mixing

Although data for the GIWW was limited, and the GIWW was not sampled or analyzed as part of the IHNC characterization effort, sufficient information regarding channel geometry and flow rate was available to estimate mixing zone dimensions necessary to achieve required dilutions.

Currents on the GIWW and Mississippi River-Gulf Outlet (MR-GO) are affected by tidal action and freshwater inflows. Reportedly, the mean annual velocity in the channel is about 0.6 fps, but may exceed 2 fps on ebb or flood tides. During periods of low inflows into the lake, July through November, surface ebb and bottom velocities average about 0.8 and 1.7 fps, respectively. Both may exceed 2 fps. Based on a mean annual velocity of 0.6 fps and an estimated cross-sectional area of 2661 m^3, average flow in the GIWW was estimated to be approximately 17,000 cfs. (These estimates should be reviewed, however, when more information is available regarding the impacts of planned hurricane protection structures on the tidal exchange in this area.)

Mixing zone requirements are set forth in Louisiana State Environmental Regulatory Code Part IX, Subpart 1, Chapter 11, §1115C, and are further described in Section 4.1.4 of this report (under standard elutriate evaluations). One requirement of these regulations (as previously discussed) is that nearby mixing zones must be taken into consideration such that overlapping mixing zones do not impair any designated water use in the receiving water body when the water body is considered as a whole. There are no known point source discharges (governed by mixing zones) in this reach of the GIWW[2] and it is therefore believed that there are no mixing zones that would overlap with the CDF mixing zone. The only drinking water intake that could be found is located on the Mississippi River, between mile markers 93 and 83, located at 29° 55' 31.046"N, 89° 57' 34.925"W, and serving St. Bernard Parish waterworks.[3] This intake will not be impacted by effluent and runoff discharges to the GIWW or Bayou Bienvenue.

The GIWW would be classified as a Category 3 water body (tidal channel with flow greater than 100 cubic feet per second (cfs) (Louisiana State Environmental Regulatory Code Part IX, Subpart 1, Chapter 11, §1115C). For such a water body, the zone of initial dilution (within which acute criteria may be exceeded) is restricted to 10 cfs or 1/30 of the flow, whichever is greater. In this case, the average flow in the GIWW was estimated to be approximately 17,000 cfs. The zone of initial dilution would be restricted to 1/30 of the cross-sectional area. Similarly, the mixing zone is restricted to 100 cfs or 1/3 of the flow, whichever is greater. The allowable mixing zone would therefore be restricted to 1/3 of the cross-sectional area of the GIWW.

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[2] Personal Communication. February 28, 2008. Rodney Mach, U.S. Army Engineer District, New Orleans.

[3] Personal Communication. April 2, 2008. Jesse Means, State of Louisiana.

Table 34. Maximum modified elutriate concentration, DMMU1 and Bayou Bienvenue background concentrations, available marine criteria/standards and dilution ratios for effluent discharge in the GIWW and Bayou Bienvenue.

						Federal				US EPA Region 4		State of Louisiana						GIWW (DMMU1)		Bayou Bienvenue	
		DMMU1 Site Water Concentration		Bayou Bienvenue Site Water Concentration		Primary		Primary & Secondary		Water Quality Screening Values for Hazardous Waste Sites		Marine		Brackish		Minimum Federal or Louisiana Acute Criteria or Standard	Minimum Federal or Louisiana Chronic Criteria or Standard	Dilution Ratios		Dilution Ratios	
Contaminants	Maximum Elutriate Concentration	Reported	Assumed	Reported	Assumed	Acute Toxicity Primary Criteria	hronic Toxicity Primary Criteria	Acute Toxicity Criteria	Chronic Toxicity Criteria	Acute Toxicity Criteria	Chronic Toxicity Criteria	Acute Standards	Chronic Standards	Acute Standards	Chronic Standards			Meeting Acute Criteria	Meeting Chronic Criteria	Meeting Acute Criteria	Meeting Chronic Criteria
	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L				
Metals																					
Aluminum	200000	17.9 B	17.9	6.0 B J	6													NS[1]	NS	NS	NS
Antimony	11.2	0.34 B	0.34	0.78 B	0.78													NS	NS	NS	NS
Arsenic	37.8	5.1	5.1	6	6	69	36	69	36	69a	36a	69	36	69	36	69	36	0	0.06	0	0.06
Barium	1660	80	80	114	114													NS	NS	NS	NS
Beryllium	9.6	1.3 B	1.3	1.0 U	0.5													NS	NS	NS	NS
Cadmium	2.1	5.0 U	2.5	1.0 U	0.5	40	8.8	40	8.8	40	8.8	45.35	10	15	0.62	15	0.62	0	d	0	12
Chromium III	216	6.6	6.6	6.1	6.1					1030	103	515	103	310	103	310	103	0	1	0	1
Chromium VI	42.0	0.010 U	0.005	0.010 U	0.005	1100	50	1100	50	1100	50	1100	50	16	11	16	11	2	3	2	3
Copper	281i	3.6 B	3.6	2.4 J	2.4	4.8	3.1	4.8	3.1	4.8	3.1	3.63	3.63	3.63	3.63	3.63	3.1	770	770	226	397
Lead	147j	0.46 B	0.46	0.39 B J	0.39	210	8.1	210	8.1	210	8.1	209	8.08	30	1.2	30	1.2	4	197	4	180
Mercury	0.28	0.20 U	0.1	0.20 U	0.1	1.8	0.94	1.8	0.94	1.8	0.940	2	0.0250	2	0.012	1.8	0.012	0	17	0	17
Nickel	133	0.87 B	0.87	3.6	3.6	74	8.2	74	8.2	74	8.2	74	8.2	74	8.2	74	8.2	0.81	17	0.84	27
Selenium	61.4	26.5	26.5	2.4 B	2.4	290	71	290	71	290	71					290	71	0	0	0	0
Thallium	1.9	0.18 B	0.18	0.095 B J	0.095			2130b		213	21.3					2130		0	0g	0	0g
Tin	13.5	25.0 U	12.5	8.1	8.1													NS	NS	NS	NS
Zinc	522	15.6 B	15.6	7.4	7.4	90	81	90	81	90	81	90	81	64	58	64	58	9	11	8	9
Organotins																					
Dibutyltin	0.8	.037U	0.0185	.037U	0.0185													NS	NS	NS	NS
Tributyltin	6.7	0.042 U	0.021	0.043 U	0.0215	0.42c	0.0074c	0.42c	0.0074c		0.01					0.42	0.0074	16	3179	16	3105
Inorganic/General Chemistry																					
Ammonia-N	19600	0.16	0.16	0.10 U	0.05	11000e	1700e									11000	1700	0.78	11	0.78	11
Cyanide	6.6	10.0 U	5	10.0 U	5	1	1	1	1	1	1	1		1		1	1	2	2	2	2
PAH's																					
2-Methylnaphthalene	0.87	0.19 U	0.095	0.19 U	0.095													NS	NS	NS	NS
Acenaphthene	0.97	0.19 U	0.095	0.19 U	0.095			970b	710b	97	9.7					970	710	0	0	0	0
Acenaphthylene	0.05	0.19 U	0.095	0.19 U	0.095													NS	NS	NS	NS
Anthracene	0.43	0.19 U	0.095	0.19 U	0.095													NS	NS	NS	NS
Benzo(a)anthracene	0.25	0.19 U	0.095	0.19 U	0.095													NS	NS	NS	NS
Benzo(a)pyrene	0.16	0.19 U	0.095	0.19 U	0.095													NS	NS	NS	NS

Contaminants	Maximum Elutriate Concentration	DMMU1 Site Water Concentration		Bayou Bienvenue Site Water Concentration		Federal				US EPA Region 4		State of Louisiana				Minimum Federal or Louisiana Acute Criteria or Standard	Minimum Federal or Louisiana Chronic Criteria or Standard	GIWW (DMMU1)		Bayou Bienvenue	
						Primary		Primary & Secondary		Water Quality Screening Values for Hazardous Waste Sites		Marine		Brackish				Dilution Ratios		Dilution Ratios	
		Reported	Assumed	Reported	Assumed	Acute Toxicity Primary Criteria	hronic Toxicity Primary Criteria	Acute Toxicity Criteria	Chronic Toxicity Criteria	Acute Toxicity Criteria	Chronic Toxicity Criteria	Acute Standards	Chronic Standards	Acute Standards	Chronic Standards			Meeting Acute Criteria	Meeting Chronic Criteria	Meeting Acute Criteria	Meeting Chronic Criteria
	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L				
Benzo(b)fluoranthene	0.25	0.19 U	0.095	0.19 U	0.095													NS	NS	NS	NS
Benzo(g,h,i)perylene	0.052	0.19 U	0.095	0.19 U	0.095													NS	NS	NS	NS
Benzo(k)fluoranthene	0.1	0.19 U	0.095	0.19 U	0.095													NS	NS	NS	NS
Chrysene	0.23	0.19 U	0.095	0.19 U	0.095													NS	NS	NS	NS
Dibenzofuran	0.19	0.95 U	0.475	0.94 U	0.475													NS	NS	NS	NS
Fluoranthene	1.4	0.19 U	0.095	0.19 U	0.095					4	1.6							0g	0g	0g	0g
Fluorene	0.76	0.19 U	0.095	0.19 U	0.095													NS	NS	NS	NS
Naphthalene	0.24	0.19 U	0.095	0.19 U	0.095					235	23.5							0g	0g	0g	0g
Phenanthrene	0.74	0.19 U	0.095	0.082 J	0.082													NS	NS	NS	NS
Pyrene	1	0.19 U	0.095	.19U	0.095													NS	NS	NS	NS
Semi-Volatile Organic Compounds																					
2-Chlorophenol	0.45	0.95 U	0.475	0.94 U	0.47									258	129	129	258	0	0	0	0
Benzoic acid	0.8	4.8 U	2.4	0.51 J	0.51													NS	NS	NS	NS
Benzyl butyl phthalate	0.2	0.95 U	0.475	.94U	0.47					294.4	29.4							0g	0g	0g	0g
Bis(2-ethylhexyl) phthalate	6.5	0.61 J	0.61	0.29 J	0.29													NS	NS	NS	NS
Diethyl phthalate	0.32	0.95 U	0.475	0.94 U	0.47					759	75.9							0g	0g	0g	0g
Di-n-butyl phthalate	0.12	0.95 U	0.475	0.94 U	0.47						3.4							NS	0g	NS	0g
Di-n-octyl phthalate	0.069	0.95 U	0.475	0.94 U	0.47													NS	NS	NS	NS
Phenol	0.15	0.19 U	0.095	0.2	0.2			5800b		580	58	580	290	580	290	580	290	0	0	0	0
Chlorinated Pesticides																					
Aldrin	0.014	0.0088	0.0088	0.0027	0.0027	1.3		1.3		1.3	0.13	1.3		1.3		1.3		0	0g	0	0g
alpha-BHC	0.0034	0.0013 U	0.00065	0.0026 U	0.0013						1400							NS	0g	NS	0g
alpha-Chlordane	0.0047	0.0013 U	0.00065	0.0028 PG	0.0028	0.09f	0.004f	0.09f	0.004f	0.09f	0.004f					0.09	0.0040	0	0.21	0	0.58
beta-BHC	0.03	0.0013 U	0.00065	0.0026 U	0.0013													NS	NS	NS	NS
delta-BHC	0.28	0.090 PG N	0.09	0.084 PG N	0.084													NS	NS	NS	NS
Dieldrin	0.082	0.0059	0.0059	0.00054 J	0.00054	0.71	0.0019	0.71	0.0019	0.71	0.0019	0.71	0.0019	0.2374	0.0019	0.2374	0.0019	0	128	0	59
Endosulfan I	0.0029	0.0013 U	0.00065	0.00083 J	0.00083	0.034	0.0087	0.034	0.0087	0.034	0.0087	0.034	0.0087	0.034	0.0087	0.034	0.0087	0	0	0	0
Endosulfan II	0.039	0.0092 PG N	0.0092	0.019 PG	0.019	0.034	0.0087	0.034	0.0087	0.034	0.0087					0.034	0.0087	0.20	31	0.33	10
Endosulfan sulfate	0.047	0.0013 U	0.00065	0.0026 U	0.0013													NS	NS	NS	NS

		DMMU1 Site Water Concentration		Bayou Bienvenue Site Water Concentration		Federal				US EPA Region 4		State of Louisiana				Minimum Federal or Louisiana Acute Criteria or Standard	Minimum Federal or Louisiana Chronic Criteria or Standard	GIWW (DMMU1)		Bayou Bienvenue	
						Primary		Primary & Secondary		Water Quality Screening Values for Hazardous Waste Sites		Marine		Brackish				Dilution Ratios		Dilution Ratios	
Contaminants	Maximum Elutriate Concentration	Reported	Assumed	Reported	Assumed	Acute Toxicity Primary Criteria	hronic Toxicity Primary Criteria	Acute Toxicity Criteria	Chronic Toxicity Criteria	Acute Toxicity Criteria	Chronic Toxicity Criteria	Acute Standards	Chronic Standards	Acute Standards	Chronic Standards			Meeting Acute Criteria	Meeting Chronic Criteria	Meeting Acute Criteria	Meeting Chronic Criteria
	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L				
Endrin	0.0027	0.0014 PG N	0.0014	0.0026 U	0.0013	0.037	0.0023	0.037	0.0023	0.037	0.0023	0.037	0.0023	0.037	0.0023	0.037	0.0023	0	0.44	0	0.40
Endrin aldehyde	0.037	0.0013 U	0.00065	0.0026 U	0.0013													NS	NS	NS	NS
gamma-BHC (Lindane)	0.029	0.01	0.01	0.0050 PG N	0.005	0.16		0.16		0.16	0.016	0.16		0.16		0.16		0	2.17g	0	1g
gamma-Chlordane	0.066	0.0013 U	0.00065	0.0072 PG	0.0072	0.09f	0.004f	0.09f	0.004f	0.09f	0.004f					0.09	0.004	0	19	0	81
Heptachlor	0.025	0.0013 U	0.00065	0.054 PG N	0.054	0.053	0.0036	0.053	0.0036	0.053	0.0036					0.053	0.0036	0	7	0	d,g
Methoxychlor	0.052	0.0025 U	0.00125	0.0050 U	0.0025		0.03c		0.03c		0.03						0.03	NS	0.77	NS	0.80
p,p'-DDD (4,4')	0.14	0.0013 U	0.00065	0.0026 U	0.0013					0.25	0.025	1.25	0.25	0.03	0.006	0.03	0.006	4	25	4	29
p,p'-DDE (4,4')	0.069	0.0013 U	0.00065	0.0058 PG N	0.0058					1.4	0.14							0g	0g	0g	0g
p,p'-DDT (4,4')	0.0059	0.0011 J PG	0.0011	0.0026 U	0.0013	0.13	0.001	0.13	0.001	0.13	0.001	0.13	0.001	0.13	0.001	0.13	0.001	0	43	0	34
PCBs																					
PCB(Aroclor-1016)	0.84	0.0094 U	0.0047	0.020 U	0.01					1.05	0.03							0g	321g	0g	41g
PCB(Aroclor-1248)	0.24	0.0094 U	0.0047	0.020 U	0.01					1.05	0.03							0g	8g	0g	11g
PCB(Aroclor-1254)	0.45	0.036	0.036	0.020 U	0.01					1.05	0.03							0g	114g	0g	21g
PCB(Aroclor-1260)	1.6	0.017	0.017	0.020 U	0.01					1.05	0.03							0.53g	121g	0.53g	79g
PCB Total	2.2	0.053	0.053	0.020 U	0.01		0.03	10b	0.03		0.03	10	0.03	2	0.014	2	0.014	0.10	404	0.10	547
																	Maximum	770	3179	226	3105
																	Mean	21h	139h	7h	120h
																	Minimum	0	0	0	0
1 NS - no standard																					

a As III, b outdated national ambient water quality criteria, c non-priority pollutant, d assumed background concentration exceeds criteria, elutriate concentration near background concentration, dilution ratio cannot be calculated, e EPA 440/5-88-004 Ammonia saltwater criteria document salinity 10 ppt, pH 7.6, T 25 deg C, f chlordane species not specified, g based on EPA Region IV screening water quality criteria for hazardous waste sites, h average values include dilutions based on alternative criteria, i Maximum copper concentration of 281 µg/L associated with DMMU 10 Composite 3&4N considered unreliable. Highest reliable value is 6. µg/L, for sample ID 04000005WTWAMD, resulting in dilutions of: GIWW Acute 8/Chronic 8, and Bayou Bienvenue Acute 3, Chronic 5, j Maximum lead concentration of 147 µg/L associated with DMMU 10 Composite 3&4N considered unreliable. Highest reliable value is 7 µg/L l, Sample ID 4500008NWNWAMD, resulting in the following dilutions: GIWW Acute 0/Chronic 8, Bayou Bienvenue Acute 0/Chronic 8

B Compound was detected in the method blank. J Compound detected but below the reporting limit (the value given is an estimate). N The RPD between the results from both columns is > 100%. PG The % difference between the results from both columns is >40% (SW846). U Compound analyzed but not detected.

Table 35. Mean (geometric) modified elutriate concentration, DMMU1 and Bayou bienvenue background concentrations, available marine criteria/standards and dilution ratios for effluent discharge in the GIWW and Bayou Bienvenue

						Federal				US EPA Region 4		State of Louisiana						GIWW (DMMU1)		Bayou Bienvenue	
		DMMU1 Site Water Concentration		Bayou Bienvenue Site Water Concentration		Primary		Primary & Secondary		Water Quality Screening Values for Hazardous Waste Sites		Marine		Brackish		Minimum Federal or Louisiana Acute Criteria or Standard	Minimum Federal or Louisiana Chronic Criteria or Standard	Dilution Ratios		Dilution Ratios	
Contaminants	Mean (Geometric) Elutriate Concentration	Reported	Assumed	Reported	Assumed	Acute Toxicity Primary Criteria	Chronic Toxicity Primary Criteria	Acute Toxicity Criteria	Chronic Toxicity Criteria	Acute Toxicity Criteria	Chronic Toxicity Criteria	Acute Standards	Chronic Standards	Acute Standards	Chronic Standards			Meeting Acute Criteria	Meeting Chronic Criteria	Meeting Acute Criteria	Meeting Chronic Criteria
	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L				
Metals																					
Aluminum	200	17.9 B	17.9	6.0 B J	6													NS	NS	NS	NS
Antimony	2.35	0.34 B	0.34	0.78 B	0.78													NS	NS	NS	NS
Arsenic	5.92	5.1	5.1	6	6	69	36	69	36	69a	36a	69	36	69	36	69	36	0	0	0	0
Barium	641	80	80	114	114													NS	NS	NS	NS
Beryllium	1.68	1.3 B	1.3	1.0 U	0.5													NS	NS	NS	NS
Cadmium	1.55	5.0 U	2.5	1.0 U	0.5	40	8.8	40	8.8	40	8.8	45.35	10	15	0.62	15	0.62	0	d	0	8
Chromium III	5.28	6.6	6.6	6.1	6.1					1030	103	515	103	310	103	310	103	0	0	0	0
Chromium VI	5.12	0.010 U	0.005	0.010 U	0.005	1100	50	1100	50	1100	50	1100	50	16	11	16	11	0	0	0	0
Copper	3.09	3.6 B	3.6	2.4 J	2.4	4.8	3.1	4.8	3.1	4.8	3.1	3.63	3.63	3.63	3.63	3.63	3.1	0	0	0	0
Lead	1.18	0.46 B	0.46	0.39 B J	0.39	210	8.1	210	8.1	210	8.1	209	8.08	30	1.2	30	1.2	0	0	0	0
Mercury	0.0979	0.20 U	0.1	0.20 U	0.1	1.8	0.94	1.8	0.94	1.8	0.94	2	0.025	2	0.012	1.8	0.012	0	d	0	d
Nickel	3.34	0.87 B	0.87	3.6	3.6	74	8.2	74	8.2	74	8.2	74	8.2	74	8.2	74	8.2	0	0	0	0
Selenium	27.8	26.5	26.5	2.4 B	2.4	290	71	290	71	290	71					290	71	0	0	0	0
Thallium	0.502	0.18 B	0.18	0.095 B J	0.095			2130b		213	21.3					2130		0	0g	0	0g
Tin	10.9	25.0 U	12.5	8.1	8.1													NS	NS	NS	NS
Zinc	8.94	15.6 B	15.6	7.4	7.4	90	81	90	81	90	81	90	81	64	58	64	58	0	0	0	0
Organotins																					
Dibutyltin	0.0221	.037U	0.0185	.037U	0.0185													NS	NS	NS	NS
Tributyltin	0.0352	0.042 U	0.021	0.043 U	0.0215	0.42c	0.0074c	0.42c	0.0074c		0.01					0.4200	0.0074	0	6	0	5
Inorganic/General Chemistry																					
Ammonia-N	5712	0.16	0.16	0.10 U	0.05	11000e	1700e									11000	1700	0	2	0	2
Cyanide	4.00	10.0 U	5	10.0 U	5	1	1	1	1	1	1	1		1		1	1	d	d	d	d
PAH's																					
2-Methylnaphthalene	0.102	0.19 U	0.095	0.19 U	0.095													NS	NS	NS	NS
Acenaphthene	0.141	0.19 U	0.095	0.19 U	0.095			970b	710b	97	9.7					970	710	0	0	0	0
Acenaphthylene	0.0959	0.19 U	0.095	0.19 U	0.095													NS	NS	NS	NS
Anthracene	0.104	0.19 U	0.095	0.19 U	0.095													NS	NS	NS	NS
Benzo(a)anthracene	0.0920	0.19 U	0.095	0.19 U	0.095													NS	NS	NS	NS
Benzo(a)pyrene	0.0958	0.19 U	0.095	0.19 U	0.095													NS	NS	NS	NS

Contaminants	Mean (Geometric) Elutriate Concentration	DMMU1 Site Water Concentration		Bayou Bienvenue Site Water Concentration		Federal				US EPA Region 4		State of Louisiana				Minimum Federal or Louisiana Acute Criteria or Standard	Minimum Federal or Louisiana Chronic Criteria or Standard	GIWW (DMMU1)		Bayou Bienvenue	
						Primary		Primary & Secondary		Water Quality Screening Values for Hazardous Waste Sites		Marine		Brackish				Dilution Ratios		Dilution Ratios	
		Reported	Assumed	Reported	Assumed	Acute Toxicity Primary Criteria	Chronic Toxicity Primary Criteria	Acute Toxicity Criteria	Chronic Toxicity Criteria	Acute Toxicity Criteria	Chronic Toxicity Criteria	Acute Standards	Chronic Standards	Acute Standards	Chronic Standards			Meeting Acute Criteria	Meeting Chronic Criteria	Meeting Acute Criteria	Meeting Chronic Criteria
	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L				
PAH's (cont.)																					
Benzo(b)fluoranthene	0.0950	0.19 U	0.095	0.19 U	0.095													NS	NS	NS	NS
Benzo(g,h,i)perylene	0.0944	0.19 U	0.095	0.19 U	0.095													NS	NS	NS	NS
Benzo(k)fluoranthene	0.0964	0.19 U	0.095	0.19 U	0.095													NS	NS	NS	NS
Chrysene	0.0920	0.19 U	0.095	0.19 U	0.095													NS	NS	NS	NS
Dibenzofuran	0.386	0.95 U	0.475	0.94 U	0.475													NS	NS	NS	NS
Fluoranthene	0.122	0.19 U	0.095	0.19 U	0.095					4	1.6							0g	0g	0g	0g
Fluorene	0.119	0.19 U	0.095	0.19 U	0.095													NS	NS	NS	NS
Naphthalene	0.100	0.19 U	0.095	0.19 U	0.095					235	23.5							0g	0g	0g	0g
Phenanthrene	0.123	0.19 U	0.095	0.082 J	0.082													NS	NS	NS	NS
Pyrene	0.120	0.19 U	0.095	.19U	0.095													NS	NS	NS	NS
Semi-Volatile Organic Compounds																					
2-Chlorophenol	0.484	0.95 U	0.475	0.94 U	0.47									258	129	129	258	0	0	0	0
Benzyl butyl phthalate	0.448	0.95 U	0.475	.94U	0.47					294.4	29.4							0g	0g	0g	0g
Bis(2-ethylhexyl) phthalate	0.524	0.61 J	0.61	0.29 J	0.29													NS	NS	NS	NS
Diethyl phthalate	0.481	0.95 U	0.475	0.94 U	0.47					759	75.9							0g	0g	0g	0g
Di-n-butyl phthalate	0.457	0.95 U	0.475	0.94 U	0.47						3.4							NS	NS	NS	0g
Di-n-octyl phthalate	0.468	0.95 U	0.475	0.94 U	0.47													NS	NS	NS	NS
Phenol	0.0979	0.19 U	0.095	0.2	0.2			5800b		580	58	580	290	580	290	580	290	0	0	0	0
Benzoic acid	2.38	4.8 U	2.4	0.51 J	0.51													NS	NS	NS	NS
Chlorinated Pesticides																					
4,4'-DDD	0.00251	0.0013 U	0.00065	0.0026 U	0.0013					0.25	0.025	1.25	0.25	0.03	0.0060	0.03	0.0060	0	0	0	0
Aldrin	0.00148	0.0088	0.0088	0.0027	0.0027	1.3		1.3		1.3	0.13	1.3		1.3		1.3		0	0g	0	0g
alpha-BHC	0.00136	0.0013 U	0.00065	0.0026 U	0.0013						1400							NS	0g	NS	0g
alpha-Chlordane	0.00136	0.0013 U	0.00065	0.0028 PG	0.0028	0.09f	0.004f	0.09f	0.004f	0.09f	0.004f					0.09	0.004	0	0	0	0
beta-BHC	0.00170	0.0013 U	0.00065	0.0026 U	0.0013													NS	NS	NS	NS
delta-BHC	0.00323	0.090 PG N	0.09	0.084 PG N	0.084													NS	NS	NS	NS
Dieldrin	0.00190	0.0059	0.0059	0.00054 J	0.00054	0.71	0.0019	0.71	0.0019	0.71	0.0019	0.71	0.0019	0.2374	0.0019	0.2374	0.0019	0	d	0	0
Endosulfan I	0.00127	0.0013 U	0.00065	0.00083 J	0.00083	0.034	0.0087	0.034	0.0087	0.034	0.0087	0.034	0.0087	0.034	0.0087	0.034	0.0087	0	0	0	0
Endosulfan II	0.00188	0.0092 PG N	0.0092	0.019 PG	0.019	0.034	0.0087	0.034	0.0087	0.034	0.0087					0.034	0.0087	0	0	0	0
Endosulfan sulfate	0.00197	0.0013 U	0.00065	0.0026 U	0.0013													NS	NS	NS	NS

Contaminants	Mean (Geometric) Elutriate Concentration	DMMU1 Site Water Concentration		Bayou Bienvenue Site Water Concentration		Federal				US EPA Region 4		State of Louisiana				Minimum Federal or Louisiana Acute Criteria or Standard	Minimum Federal or Louisiana Chronic Criteria or Standard	GIWW (DMMU1)		Bayou Bienvenue	
						Primary		Primary & Secondary		Water Quality Screening Values for Hazardous Waste Sites		Marine		Brackish				Dilution Ratios		Dilution Ratios	
		Reported	Assumed	Reported	Assumed	Acute Toxicity Primary Criteria	Chronic Toxicity Primary Criteria	Acute Toxicity Criteria	Chronic Toxicity Criteria	Acute Toxicity Criteria	Chronic Toxicity Criteria	Acute Standards	Chronic Standards	Acute Standards	Chronic Standards			Meeting Acute Criteria	Meeting Chronic Criteria	Meeting Acute Criteria	Meeting Chronic Criteria
	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L				
Chlorinated Pesticides (cont.)																					
Endrin	0.00128	0.0014 PG N	0.0014	0.0026 U	0.0013	0.037	0.0023	0.037	0.0023	0.037	0.0023	0.037	0.0023	0.037	0.0023	0.037	0.0023	0	0	0	0
Endrin aldehyde	0.00145	0.0013 U	0.00065	0.0026 U	0.0013													NS	NS	NS	NS
gamma-BHC (Lindane)	0.00209	0.01	0.01	0.0050 PG N	0.005	0.16		0.16		0.16	0.016	0.16		0.16		0.16		0	0g	0	0g
gamma-Chlordane	0.00217	0.0013 U	0.00065	0.0072 PG	0.0072	0.09f	0.004f	0.09f	0.004f	0.09f	0.004f					0.09	0.004	0	0	0	0
Heptachlor	0.00162	0.0013 U	0.00065	0.054 PG N	0.054	0.053	0.0036	0.053	0.0036	0.053	0.0036					0.053	0.0036	0	0	0	0
Heptachlor epoxide	0.00151	0.0055	0.0055	0.0026 U	0.0013	0.053	0.0036	0.053	0.0036	0.053	0.0036					0.053	0.0036	0	0	0	0
Methoxychlor	0.00301	0.0025 U	0.00125	0.0050 U	0.0025		0.03c		0.03c		0.03						0.03	NS	0	NS	0
p,p'-DDE (4,4')	0.00206	0.0013 U	0.00065	0.0058 PG N	0.0058					1.4	0.14							0g	0g	0g	0g
p,p'-DDT (4,4')	0.00143	0.0011 J PG	0.0011	0.0026 U	0.0013	0.13	0.001	0.13	0.001	0.13	0.001	0.13	0.001	0.13	0.001	0.13	0.001	0	2	0	0
PCBs																					
PCB(Aroclor-1016)	0.0160	0.0094 U	0.0047	0.020 U	0.01					1.05	0.03							0g	0g	0g	0g
PCB(Aroclor-1248)	0.0192	0.0094 U	0.0047	0.020 U	0.01					1.05	0.03							0g	0g	0g	0g
PCB(Aroclor-1254)	0.0217	0.036	0.036	0.020 U	0.01					1.05	0.03							0g	0g	0g	0g
PCB(Aroclor-1260)	0.0247	0.017	0.017	0.020 U	0.01					1.05	0.03							0g	0g	0g	0g
PCB Total	0.0387	0.053	0.053	0.020 U	0.01		0.03	10b	0.03		0.03	10	0.03	2	0.014	2	0.014	0	d	0	6
																	Maximum	0	6	0	8
																	Mean	0h	0.28h	0h	0.54h
																	Minimum	0	0	0	0

1 NS - no standard

a As III, b outdated national ambient water quality criteria, c non-priority pollutant, d assumed background concentration exceeds criteria, elutriate concentration near background concentration, dilution ratio cannot be calculated, e EPA 440/5-88-004 Ammonia saltwater criteria document salinity 10 ppt, pH 7.6, T 25 deg C, f chlordane species not specified, g based on EPA Region IV screening water quality criteria for hazardous waste sites, h average values include dilutions based on alternative criteria

B Compound was detected in the method blank. J Compound detected but below the reporting limit (the value given is an estimate). N The RPD between the results from both columns is > 100%. PG The % difference between the results from both columns is >40% (SW846). U Compound analyzed but not detected.

Mixing zone curves were generated from CDFATE (Chase 1994), a model for dredged material discharges based on EPA's CORMIX system for mixing zone determinations. Results of the mixing zone analysis (Figures 19 - 20) reflect attainable dilution as a function of distance from the discharge point. Figure 21 illustrates mixing zone width as a function of distance from discharge point, and Figure 22 illustrates the attainable dilution in the GIWW as a function of cross-sectional area. The maximum attainable dilution ratio in compliance with these mixing zone restrictions is approximately 120.

Assuming maximum copper and lead dilution requirements are revised as previously discussed, adequate dilution will be attainable within the mixing zone for all constituents except tributyltin (dilution ratio 3179 chronic), total PCBs (dilution ratio 404 chronic), Aroclor 1016 (dilution ratio 321 chronic), and dieldrin (dilution ratio 128 chronic). Effluent treatment may be required to address elevated levels of these constituents when dredging certain areas of the IHNC. However, the mixing that is inherent in dredging will likely flatten peak concentrations somewhat. Based on the geometric mean elutriate concentrations (Table 35), all dilution requirements can be met within the prescribed mixing zone in the GIWW.

If treatment is required, it is anticipated that simple broadcasting of activated carbon around the weir of the CDF will be effective in reducing effluent concentrations of organic compounds sufficiently to permit discharge. The use of activated carbon has been evaluated for another project to reduce volatile emissions from ponded water in a CDF. Bench testing will be required to establish dosage and contact time requirements to meet treatment objectives for the IHNC effluent.

Assuming maximum runoff concentrations from wet, unoxidized material can be conservatively estimated based on modified elutriate concentrations, evaluation of mixing zone requirements for runoff can be estimated based on comparison of modified elutriates to acute criteria. In this case, all dilution requirements for acute criteria can be met within the mixing zone. Determination of the mixing zone requirements for runoff from dried, oxidized material will require evaluation of the simplified laboratory runoff procedure (SLRP) data.

Bayou Bienvenue mixing

Data regarding geometry and flow rate in Bayou Bienvenue were insufficient to permit modeling of a mixing zone as was done for the GIWW. Bayou Bienvenue is sufficiently small in depth and width and the flow rate is sufficiently low that discharge from the CDF would fully envelop and mix with the entire flow of Bayou Bienvenue within approximately 200 ft of the discharge. As such, modeling is not needed and the dilution achieved is simply a ratio of the flow of Bayou Bienvenue and the CDF discharge. Flow rate within Bayou Bienvenue was estimated based on available information and appears to be quite limited, a function of tidal exchange, surface runoff, and stormwater pumping.

Stormwater pumping varies from 20 to 50 cfs on an annual basis with a characteristic average annual discharge rate of 33 cfs (National Marine Fisheries Service 1999). Pumping typically occurs no more than a few days per month and may average about 2 days per month. During these periods of pumping, the flow rate may average 500 cfs with instantaneous rates of more than 1000 cfs.

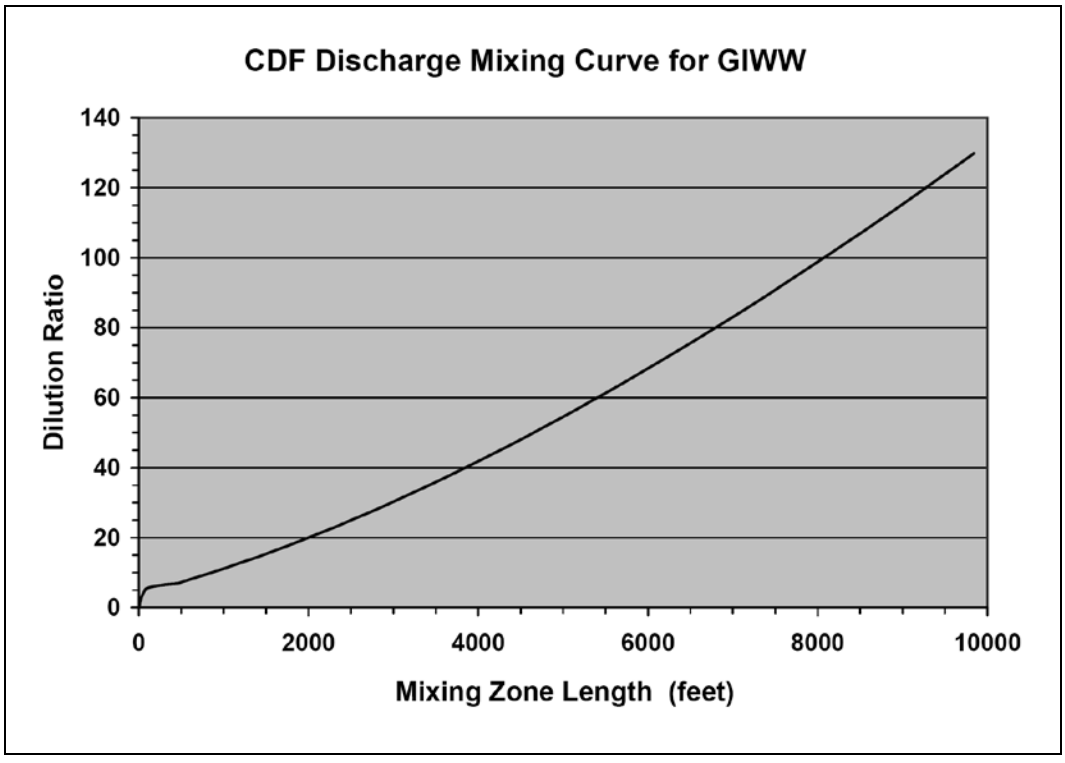

Figure 19. Attainable dilution versus mixing zone length for the GIWW.

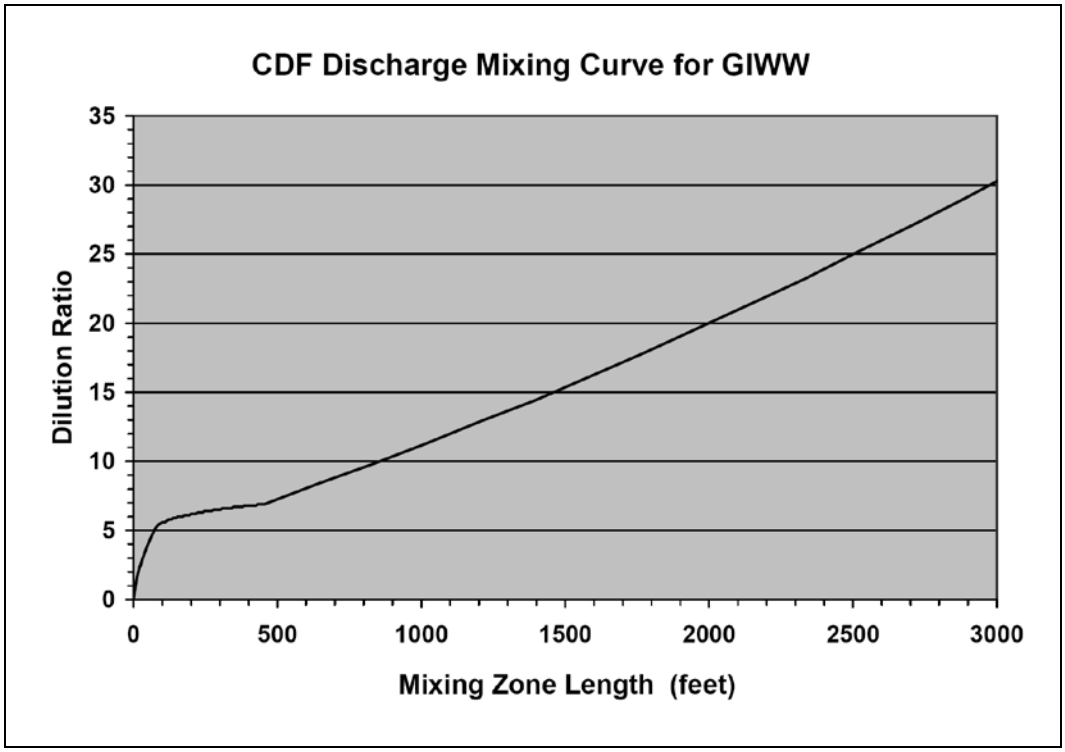

Figure 20. Attainable dilution versus mixing zone length for the GIWW (<1,000 ft).

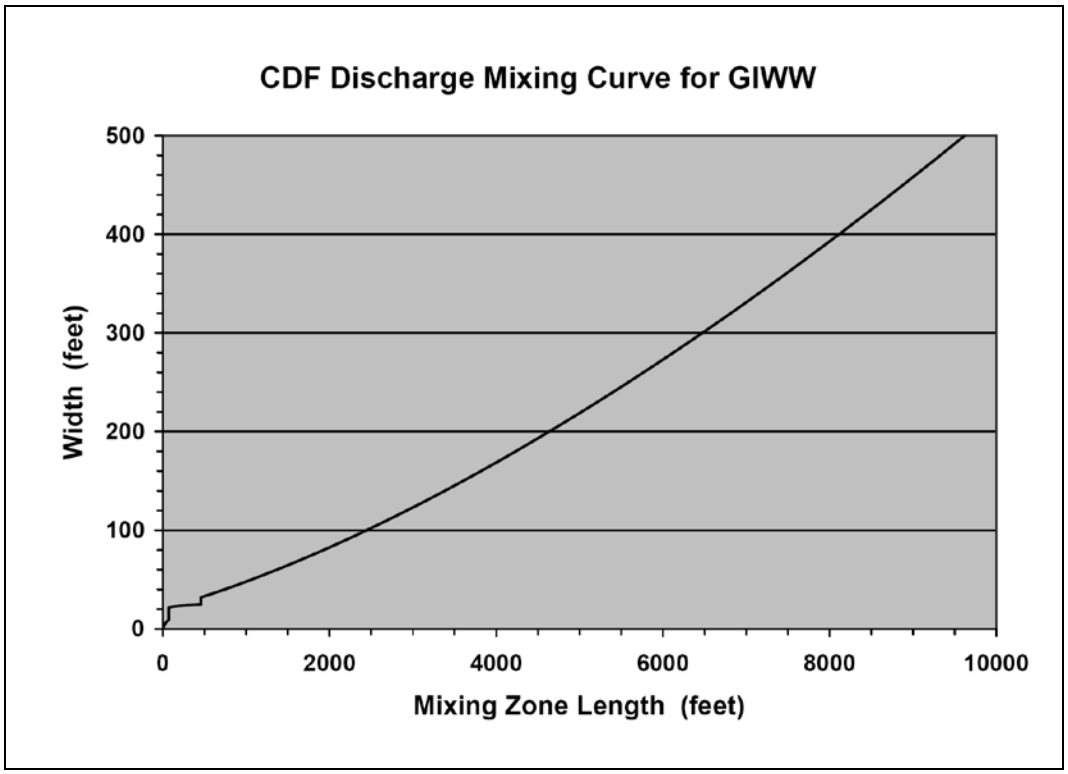

Figure 21. Mixing zone width as a function of distance from discharge point (GIWW).

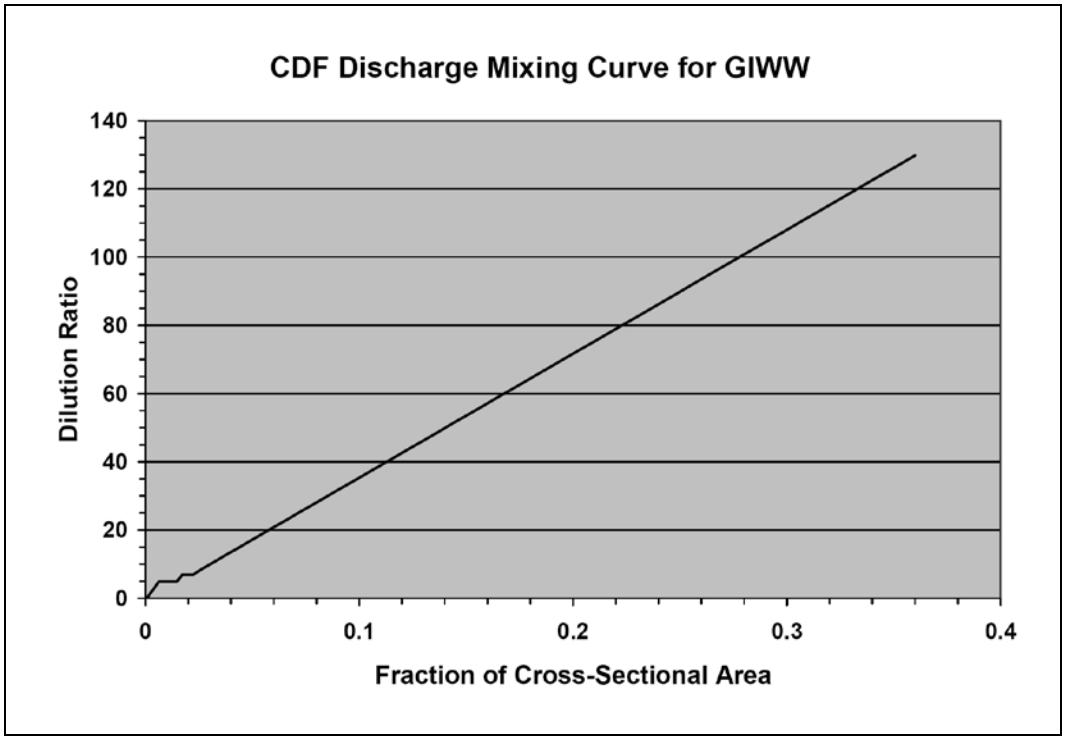

Figure 22. Attainable dilution as a function of cross-sectional area (GIWW).

The drainage area is about 2780 acres (National Marine Fisheries Service 1999). The mean annual rainfall is about 50 in., and the mean annual run-off would be about 30 in. This would yield an average annual discharge rate of 10 cfs and would average about 120 cfs on days when runoff occurs, assuming about 30 runoff events per year.

The tidal flow is diurnal with an average tidal range of 1 ft (Appendix B, Page B-3, Section B.1.9, USACE 1997). Assuming a channel width of 130 ft and channel length of 20,000 ft (with discharge taking place at the south-west corner of the CDF and along the southern edge of the CDF), the average daily tidal exchange rate is 30 cfs. (Tidal exchange may be reduced as an effect of proposed hurricane protection provisions; therefore, these assumptions should be reviewed once those structures are in place.) In addition, the open area south of the proposed disposal area experiences a daily tidal range of approximately 6 in. over an area of 440 acres, resulting in an effective flow rate of 111 cfs. This area discharges into Bayou Bienvenue, resulting in a combined flow rate in Bayou Bienvenue of approximately 141 cfs (151 cfs including average annual runoff flows). Flow would be much greater (perhaps 700 cfs) following large precipitation events (10 to 20 days per year).

At a flow rate of 141 cfs, the dilution available for effluent discharged at a rate of 47 cfs into Bayou Bienvenue is 3 parts background flow to 1 part effluent (3:1). This dilution is inadequate to meet water quality criteria for the effluent pathway without treatment.

Runoff from the CDF would be discharged at a rate up to 1 in. per day from the interior area of the CDF. The interior areas of the disposal cells range from about 35 to 120 acres. Therefore, the runoff discharge rate from the CDF ranges up to 1.5 to 5 cfs. During these days, the flow rate in Bayou Bienvenue is estimated to range from about 220 cfs to 570 cfs, depending on stormwater pumping. As such, the dilution available for runoff discharges into Bayou Bienvenue would range from 44:1 to 380:1 or greater, assuming the entire width and depth of the bayou are enveloped in the mixing zone. This is adequate to meet dilution requirements for runoff without treatment for both maximum and mean predicted concentrations. Dilution requirements for runoff from dried, oxidized material have not yet been determined but are expected to be somewhat higher due to increased solubilization of metals under oxidized conditions.

Bayou Bienvenue would be classified as a Category 4 water body (tidal channel with flow less than 100 cfs) in Louisiana State Environmental Regulatory Code Part IX, Subpart 1, Chapter 11, §1115C. For Category 4 water bodies, the zone of initial dilution is restricted to 1/10 of the average flow over one tidal cycle (effectively, 1/10 of the cross-sectional area), and the mixing zone is permitted to encompass the entire cross-sectional area and flow.

Conclusions

Based on available information, maximum attainable dilution ratio for discharge of effluent to the GIWW is 120. Assuming maximum effluent concentrations for all DMMUs, adequate dilution will be attainable within a mixing zone complying with State of Louisiana requirements for all constituents except tributyltin, total PCBs, Aroclor 1016, and dieldrin (assuming adjusted dilution requirements for copper and lead, as previously discussed). Effluent treatment may be required when dredging areas of the IHNC with elevated concentrations of these constituents. However, the mixing that is inherent in hydraulic dredging will likely reduce peak predicted effluent concentrations, as reflected by the geometric mean elutriate concentrations. For the mean predicted effluent concentrations,

all dilution requirements can be met within the prescribed mixing zone in the GIWW.

For maximum runoff concentrations discharged to the GIWW, which were conservatively estimated for the unoxidized case using effluent concentrations, all acute criteria can be met within the prescribed mixing zone (assuming adjusted dilution requirements for copper and lead, as previously discussed). Dilutions for oxidized conditions are pending evaluation of the simplified laboratory runoff procedure (SLRP) data.

Based on limited information available regarding bathymetry and flow in Bayou Bienvenue, attainable dilution will be insufficient to accommodate effluent flows. Maximum attainable dilution ratios for runoff (occurring concurrently with surface runoff and pumping to the Bayou) are estimated to range between 44 and 380, assuming the entire width and depth of the bayou are enveloped in the mixing zone. This is adequate to meet dilution requirements for runoff from unoxidized material without treatment. Dilution requirements for runoff from oxidized material have not yet been determined but are expected to be higher due to increased solubilization of metals under oxidized conditions.

Mixing evaluation for placement of dredged material in the proposed mitigation site

Objectives

The primary objective of this alternative is twofold:

- To mitigate for wetland areas potentially disturbed by construction of the CDF.
- To restore degraded wetland areas as a benefit of the project.

The area proposed for mitigation is located in a large triangular area of mostly open water (Figures 23 and 24). The selected area was reportedly not intended to be fixed in size or location, but “floatable” within the larger area as dictated by the logistics of placement, constructability of containment structures, and volume of material available and suitable for beneficial use. Total area contained within the larger triangle is estimated to be approximately 440 acres.

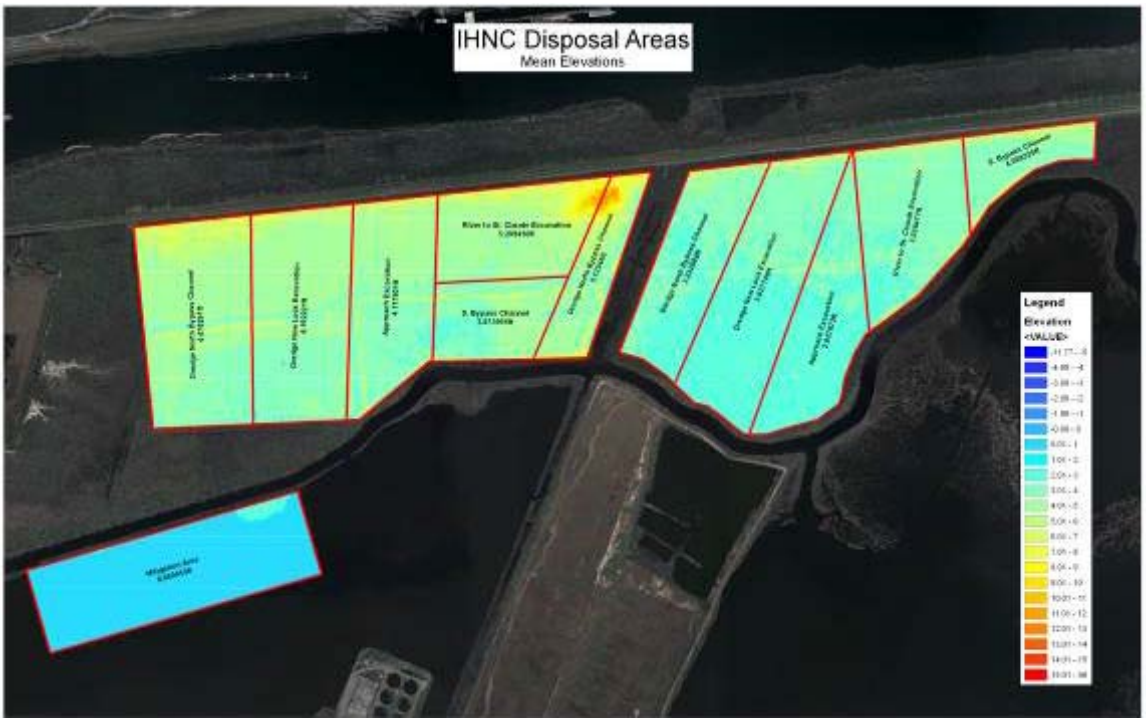

Figure 23. Representation of proposed wetland mitigation site.

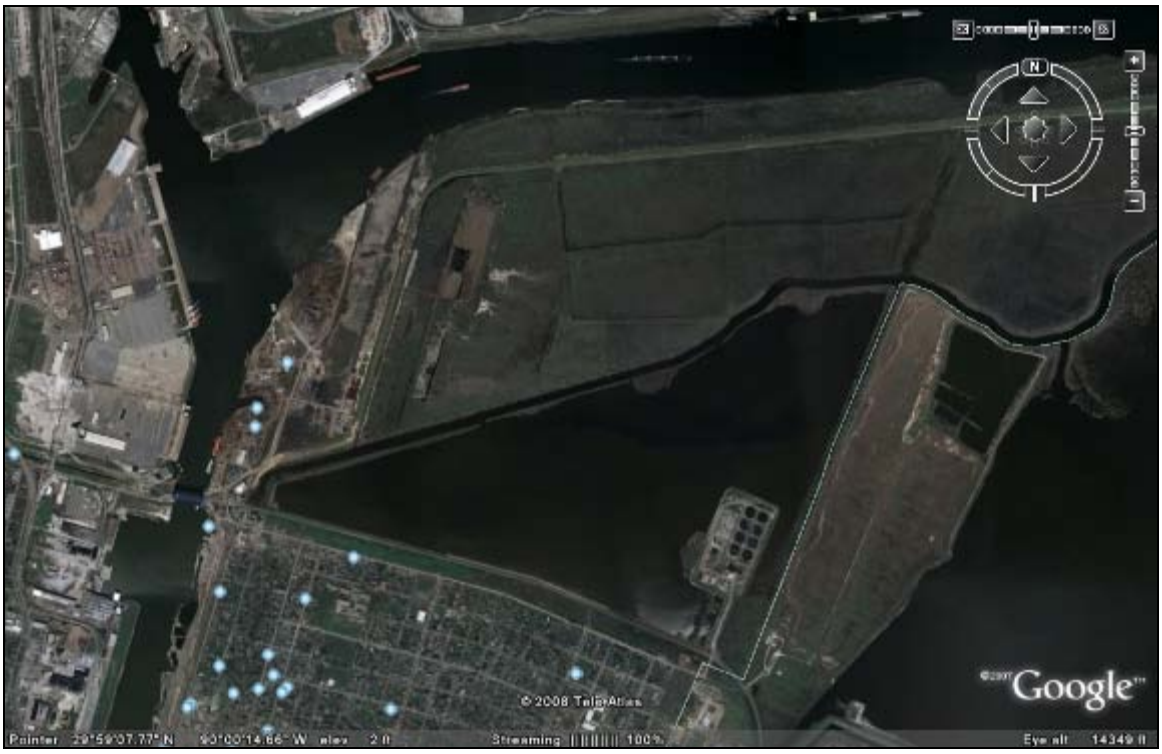

Figure 24. Triangular area containing proposed mitigation area.

The principal concern of this section of the report is evaluation of water quality impacts potentially associated with placement of dredged material in the mitigation site.

Data evaluation and dilution requirements

Material suitability

Although this section is primarily concerned with evaluation of water quality impacts associated with dredged material placement in the mitigation site, suitability for placement must take into consideration benthic toxicity and bioaccumulation potential, discussed in Chapter 3. Suitability of each DMMU for open water placement in a marine or freshwater environment was summarized in the preliminary dredging plan (USAE-ERDC 2008). The preliminary dredging plan is reproduced here in part (Table 36) along with a proposed plan for placement of some material in the mitigation site. The principal difference between the proposed plan and Alternative II, previously presented in USAE-ERDC (2008), is the diversion of suitable materials from open water disposal to placement in the mitigation site. Shaded cells in Table 36 reflect the affected materials and volumes.

Dilution requirements

Materials selected for placement in the mitigation site were chosen not only on the basis of benthic toxicity, but also based on predicted dilution requirements. Initially it was thought that a structure would be constructed that would permit containment of solids and water in much the same manner as a CDF. In that case, effluent discharges would be best represented by the modified elutriate test results. However, due to the condition of the foundation soils throughout the mitigation site, construction of some type of temporary structure, such as hay bales, may be used instead to minimize flow of solids away from the intended placement area. This would not be sufficient to completely restrict flow of the associated water, and the entire triangular area would function in somewhat the same manner as a containment area (Figure 24). Unrestricted open water disposal at the mitigation site is yet another possibility for placement of material in the mitigation site, and aspects of this may be appropriately modeled by the standard elutriate test. However, because the water depth is limited and upland will be created, aeration will have a larger effect than is typical for open water placement. Aeration would be expected to result in

greater liberation of metals to the water column. Because of the combined effects expected for dredged material placement in this area, both standard elutriate and modified elutriate results were considered as part of the mitigation site placement mixing zone evaluation.

It is anticipated that diluted effluent would ultimately discharge from the triangular area to Bayou Bienvenue. Discharge of effluent was ruled out for effluent from the CDF because dilution requirements could not be met. In this case, it is hoped that by selecting cleaner materials for placement in the mitigation site, dilution requirements would be reduced sufficiently to allow discharge to Bayou Bienvenue from the mitigation area.

In order to understand the range of dilutions the process variations might introduce, dilution ratios were initially calculated for all DMMUs suitable for placement in the marine environment. Dilution ratios were based on maximum elutriate concentrations obtained in both modified and standard elutriate tests for individual DMMUs, or parts of DMMUs (Table 36), with the mitigation site as the receiving water. These are summarized in Tables 37 and 38.

Maximum resulting dilution ratios for the modified elutriate test were:

- Acute 691 (DMMU 10k copper).
- Chronic 763 (DMMU 10k lead).

Maximum resulting dilution ratios for the standard elutriate test were:

- Acute 4314 (DMMU 10k copper).
- Chronic 5515 (DMMU 10k lead).

In addition, for both modified and standard elutriate tests, DMMU 7c and 7d required high dilutions for PCBs. There is some indication that analytical problems may be partly responsible since toxicity was not significantly higher for either DMMU 7 or DMMU 10, but this could not be resolved with the information available. Both of these DMMUs were therefore removed from consideration for placement in the mitigation site until further resolution can be obtained regarding the reliability of those results.

Resulting dilution requirements for the remaining DMMUs are illustrated graphically in Figures 25 and 26.

Mitigation site mixing

Maximum dilution required for the selected DMMUs to meet chronic water quality criteria was 170, for tributyltin (standard elutriate, DMMU 4/5), and to meet acute criteria was 18, for cyanide (modified elutriate, DMMU 6). Available dilution in the mitigation site was estimated based on total area encompassed by the entire triangular area. Flow in this area is believed to be limited to tidal fluctuations, but little definitive data was available at the time of this analysis. According to NOAA, the Gulf of Mexico experiences a diurnal tide (http://oceanservice.noaa.gov/education/kits/tides/tides07_cycles.html), with only one high and one low tide each day. Tidal range was estimated in a site visit made by MVN at low tide (0600 hours, June 16, 2008). Measurements were taken at two locations (stump and wall measurements in Figures 27 and 28). These suggest the tidal range in this location to be between roughly 5-1/2 and 6-1/4 in. This corresponds well with measurements taken by the University of Wisconsin, who obtained real-time stage measurements from June 17 and June 18, 2007 of approximately 6 in. The location of their gauge is indicated as WL in Figure 27.

Bottom elevation in the area of the proposed mitigation site ranges from approximately +1/2 to – 1-1/2 ft (NAVD88) (Hartman Engineering Inc. 2001). Hartman (2001) estimated maximum average water elevation at +1.64 ft (NGVD 29) based on the Paris Road gauge readings. (These readings did not capture tidal variations because they were taken at 0800 every day and therefore may not reflect actual maximum water levels. Also, there is a difference between reference elevations NAVD88 and NGVD 29 of approximately 0.2 ft.) These assumptions result in an estimated water depth in the mitigation area ranging from 1.14 ft to 3.14 ft (neglecting the adjustment for NAVD88 vs. NGVD 29). Assuming an average maximum water depth of 2 ft, a 6-in. tidal variation would therefore represent a daily exchange of approximately 25 percent of the maximum water volume or an effective flow rate of 111 cfs.

The mitigation site would be classified as a Category 6 water body (coastal bays and lakes) (Louisiana State Environmental Regulatory Code Part IX, Subpart 1, Chapter 11, §1115C). For such a water body, the zone of initial dilution for protection of aquatic life (within which acute criteria may be exceeded) is restricted to a radial distance of 50 ft from the point of discharge. Similarly, the mixing zone within which chronic criteria may be exceeded is restricted to a radial distance of 200 ft.

Table 36. Dredging and disposal plan (revised 7/17/08).

In-Situ Volumes by Location and Material Type (yd³)								Volume to Selected Placements Alternative II (ERDC 2008) (yd³)								Volume to Selected Placements Proposed Alternative (yd³)								Approximate Year Dredged			
		Suitability (No Benthic Toxicity)		Total Volume		Volume by Section		Float in Place				Cast in Place				Float in Place				Cast in Place							
										CDF				CDF				CDF				CDF					
DMMU/Location	Material Type[1]	FW[2]	SW[3]	FIP	CIP	FIP	CIP	Open Water	Wetland	Disposal	Fill Storage	Open Water	Wetland	Disposal	Fill Storage	Open Water	Wetland	Disposal	Fill Storage	Open Water	Wetland	Disposal	Fill Storage	Float-in-Place	Required Fill Volumes (yd³)	Cast-in-Place	Required Fill Volumes (yd³)
D1-05-1 thru 6	NN	USm[4]	USm	48,100	48,100	48100	48100	0	0	48100	0	0	0	48100	0	0	0	48100	0	0	0	48100	0	7	106762n	6	354203n
D2-05-1 thru 6	NN	USm	USm	88,700	155,200	88700	155200	0	0	88700	0	0	0	155200	0	0	0	88700	0	0	0	155200	0	7		6	
D3-05-1 thru 3	F	S[5]	S	412,750	586,300	62850	196700	412750q	0	0	0	586300q	0	0	0	0	62850a	0	0	389600	196700	0	0	2-3		2-3	
D3-05-4 thru 6	NN	S	US			349900	389600		0	0	0		0	0	0	349900a	0	0	0		0	0	0	2-3		2-3	
D3-05-1N thru 6N	N	S	US			a	a		0	0	0		0	0	0		0	0	0		0	0	0	2-3		2-3	
D4-05-1 thru 8	NN	S	US	152,800	257,800	152,800	257,800	152800	0	0	0	257800	0	0	0	152800	0	0	0	257800	0	0	0	2-3		2-3	
D5-05-1 thru 8	NN	US	US	143,400	245,200	78,500	83,500	0	0	78500	0	0	0	83500	0	0	0	78500	0	0	0	83500	0	2-3		2-3	
D4/5-05-1N-16N	N	S	S	b	b	64900h	161700h	64900q	0	0	0	161700q	0	0	0	0	64900	0	0	0	161700	0	0	2-3		2-3	
D6-05-1 & 2	NN	S	S	463,100	997,700	463,100	997,700	0	0	0	463100	346678	0	0	651022	59100	0	0	404000	346678	0	0	651022	1		1	
D6-05-3 thru 6	F	S	S																					1		1	
D6-05-1N thru 6N	N	S	S																					1		1	
D7-05-1 thru 4	NN	US	S	413,000	620,900	101500	152500	0	0	101500	0	0	0	152500	0	0	0	101500	0	0	0	152500	0	1	None	1	None
D7-05-5 thru 9	F	S	S			228000	79400	311500q	0	0	0	468400q	0	0	0	228000	0	0	0	79400	0	0	0	1		1	
D7-05-1N-4N	N	S	S			c	c																	1		1	
D7-05-5N-9N	N					83500	389000									0	83500	0	0		389000	0	0				
D8-05-1 thru 4	NN	S	US	132,000	162,000	132,000	162,000	132000	0	0	0	162000	0	0	0	132000	0	0	0	162000	0	0	0	7		7	

In-Situ Volumes by Location and Material Type (yd³)								Volume to Selected Placements Alternative II (ERDC 2008) (yd³)								Volume to Selected Placements Proposed Alternative (yd³)								Approximate Year Dredged			
		Suitability (No Benthic Toxicity)		Total Volume		Volume by Section		Float in Place				Cast in Place				Float in Place				Cast in Place							
										CDF				CDF				CDF				CDF					
DMMU/Location	Material Type[1]	FW[2]	SW[3]	FIP	CIP	FIP	CIP	Open Water	Wetland	Disposal	Fill Storage	Open Water	Wetland	Disposal	Fill Storage	Open Water	Wetland	Disposal	Fill Storage	Open Water	Wetland	Disposal	Fill Storage	Float-in-Place	Required Fill Volumes (yd³)	Cast-in-Place	Required Fill Volumes (yd³)
D9-05-1&3	NN	S	US	192,200	192,200	192,200	192,200	150000	0	0	0	150000	0	0	0	150000	0	0	0	150000	0	0	0	11		11	
D9-05-2&4	NN	S	S					42200q	0	0	0	42200q	0	0	0	0	42200	0	0	0	42200	0	0	7		7	
D10-05-1	F	S	S	131,400	131,300	18300	18300	131,400	0	0	0	131,300				131,400	0	0	0	131,300				7	246825j	7	246825j
D10-05-2	F	d	d			e	e																	7		7	
D10-05-3&4	S	S	S			113100	113000																	7		7	
D10-05-1N	N	d	d			f	f																	7		7	
D10-05-2N	N	d	d			e	e																	7		7	
D10-05-3N&4N	N	S	S			g	g																	7		7	
D11-05-1&2	NN	d	d	38,782	38,782	38782i	38782i	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11		11	
Totals				2,216,232	3,435,482	2,216,232	3,435,482	1397550q	0	316800	463100	2306378q	0	439300	651022	1203200	253450	316800	404000	1516778	789600	439300	651022	Total	353587	Total	601028
								Grand Total 2,177,450				Grand Total 3,396,700				Grand Total 2,177,450				Grand Total 3,396,700				Capping Allowance	50000	Capping Allowance	50000
																								Grand Total 403587		Grand Total 651028	

[1] Native/Non-native/Fill/Sediment, [2] Freshwater, [3] Saltwater, [4] Unsuitable, [5] Suitable, a a Native volumes included with 1-3 and 4-6 volumes above, therefore wetland placement volume is overestimated by the volume underlying DMMU 1 Sites 1-3, and the open water volume is underestimated by the same amount, b 4/5 is a vertical designation, volume included with 4 and 5, c Native below project depth (at -36ft), d Unknown assumed S, e Site 2 not sampled, f Included with 1 above, g Included with 3&4 above, h DMMU 5 native volumes only, DMMU 4 volumes were estimated as NN to full project depth, i Not scheduled for dredging, j Letter report assumes 70K of material being dredged plus remainder from previously stockpiled goes to fill. However water management at the lock fill site would be a problem if dredging hydraulically due to the small size of the site and limited hydraulic retention time, m Not tested, assumed unsuitable, n Letter report specifies backfill of West Side of New lock after U/S and D/S approach - assumed here to correspond to main north channel, q shaded areas represent material proposed for open water disposal in Alternative II (ERDC 2008), portions of which are proposed for wetland placement in proposed alternative

Table 37. Estimated dilution ratios required for individual DMMUs for placement in the mitigation site based on modified elutriate test - maximum dissolved concentration.

	DMMU3[a]		DMMU4/5[b]		DMMU6[f]		DMMU6[g]		DMMU6[h]		DMMU7[c]		DMMU7L[d]		DMMU7N[e]		DMMU9[i]		DMMU10[j]		DMMU10[k]		DMMU10[L]	
Contaminants	Acute	Chronic	Acute	Chronic	Acute	Chronic	Acute	Chronic	Acute	Chronic	Acute	Chronic	Acute	Chronic	Acute	Chronic	Acute	Chronic	Acute	Chronic	Acute	Chronic	Acute	Chronic
Metals																								
Arsenic	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.06	0	0
Cadmium	0	n	0	n	0	n	0	n	0	n	0	n	0	n	0	n	0	n	0	n	0	n	0	n
Chromium III	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Chromium VI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	NE	NE	0	0	0	0
Copper	n	n	0	0	0	0	0	n	0	n	n	n	0.25	0.25	0	n	0	0	52	52	691	691	2	2
Lead	0	0	0	26	0	0	0	0	0	0	0	15	0	n	0	n	0	0	0	69	4	763	0	5
Mercury	0	n	0	n	0	n	0	n	0	n	0	n	0	n	0	n	0	n	0	n	0	17	0	n
Nickel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0.86	45	0	0
Selenium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Silver	0.32	10 m	0.32	10 m	0.32	10 m	0.32	10 m	0.32	10 m	0.32	10 m	0.32	10 m	0.32	10 m	0.32	10 m	0.32	10 m	0.32	10 m	0.32	10 m
Zinc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	10	0	0
Organotins																								
Tributyltin	0	n	0	n	0	n	0	n	0	n	0	127	0	n	0	n	0	n	0	n	0	0	0	n
Inorganic/General Chemistry																								
Cyanide	11	11	14	14	11	11	18	18	11	11	11	11	11	11	n	n	3	3	2	2	2	2	11	11
Semi-Volatile Organic Compounds																								
Benzidine	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	NE	NE	0	0	0	0
2-Chlorophenol	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	NE	NE	0	0	0	0
2,4-Dichlorophenol	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	NE	NE	0	0	0	0
Hexachlorobutadiene	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pentachlorophenol	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	NE	NE	0	0	0	0
Phenol	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	NE	NE	0	0	0	0
Chlorinated Pesticides																								
Aldrin	0	0m	0	0m	0	0m	0	0m	0	0m	0	0m	0	0m	0	0m	0	0m	NE	NS	0	0m	0	NS
gamma-BHC (Lindane)	0	0m	0	0m	0	0m	0	0m	0	0m	0	0m	0	0m	0	0m	0	0m	0	0m	0	0m	0	0.88m
gamma-Chlordane	0	0.83	0	0	0	n	0	n	0	0	0	99	0	0	0	0	0	0	NE	NE	0	0	0	0
4,4'-DDD	0	0	0	0	0	0	0	0	0	0	4	29	0	0	0	0	0	0	0	0	0	0	0	0.30
p,p'-DDE (4,4')	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	NS	NS	0m	0m	0m	0m
p,p'-DDT (4,4')	0	4	0	n	0	n	0	9	0	34	0	39	0	n	0	1.31	0	n	NE	NE	0	n	0	n
Dieldrin	0	13	0	0	0	0	0	0.33	0	0	0	134	0	0	0	0	0	0	NE	NE	0	0	0	24

	DMMU3[a]		DMMU4/5[b]		DMMU6[f]		DMMU6[g]		DMMU6[h]		DMMU7[c]		DMMU7L[d]		DMMU7N[e]		DMMU9[i]		DMMU10[j]		DMMU10[k]		DMMU10[L]	
Contaminants	Acute	Chronic	Acute	Chronic	Acute	Chronic	Acute	Chronic	Acute	Chronic	Acute	Chronic	Acute	Chronic	Acute	Chronic	Acute	Chronic	Acute	Chronic	Acute	Chronic	Acute	Chronic
Endosulfan sulfate	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Endrin	0	1	0	0	0	0	0	0	0	0	0	14	0	0	0	0	0	0	NE	NE	0	0	0	0
Heptachlor	0	0	0	0	0	n	0	n	0	n	0	n	0	0	0	0	0	0	NE	NE	0	0	0	0
Heptachlor epoxide	0	0	0	0	0	0	0	0	0	0	0	16	0	0	0	0	0	0	NE	NE	0	0	0	0
Toxaphene	0	n	0	n	0	n	0	n	0	n	0	39	0	n	0	n	0	n	NE	NE	0	n	0	n
PCB Congeners																								
PCB Total	0	0	0	0	0	15	0	0	0	0	0.10	547	0	447	0	0	0	0	NE	NE	0	0	0	19
Maximum	11	13	14	26	11	15	18	18	11	34	11	547	11	447	0.32	10	3	10	52	69	691	763	11	24
Mean	0.37	2	0.45	2	0.36	1	0.58	2	0.36	2	0.50	40	0.36	19	0.01	0.47	0.12	0.51	4	11	23	55	0.41	3
Minimum	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0

a DMMU 3 C1-3 Land, b DMMU 4/5N Comp 1&11, Sites 4, 5, 7, 8, 12 &13, c DMMU 7 Sites 2, 3, and 4, d DMMU 7Land Sites 5, 6, 7, 8 & 9, e DMMU 7N Comp 1-9, f DMMU 6 Site 1 and 2, g DMMU 6 Land Site 3, 4, 5, & 6, h DMMU 6N Sites 1, 2, 3, 4, 5 & 6, I DMMU 9 Comp 2&4, j DMMU 10 Land Comp 3 & 4, k DMMU 10N Comp 3 & 4, l DMMU 10 Site 1, m Based on EPA Region IV Water Quality Screening Criteria for Hazardous Waste Sites, n Background Exceeds WQC and Elutriate Concentrations

Table 38. Estimated dilution ratios required for individual DMMUs for placement in the mitigation site based on standard elutriate test - maximum dissolved concentrations

	DMMU3a		DMMU4/5b		DMMU6f		DMMU6g		DMMU6h		DMMU7c		DMMU7Ld		DMMU7Ne		DMMU9i		DMMU10j		DMMU10k		DMMU10L	
Contaminants	Acute	Chronic	Acute	Chronic	Acute	Chronic	Acute	Chronic	Acute	Chronic	Acute	Chronic	Acute	Chronic	Acute	Chronic	Acute	Chronic	Acute	Chronic	Acute	Chronic	Acute	Chronic
Metals																								
Arsenic	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	6.19	0	0
Cadmium	0	n	0	n	0	n	0	n	0	n	0	n	0	n	0	n	0	n	0	n	0.05	51	0	n
Chromium III	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	6	3	13	0	0
Chromium VI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	NE	NE	0	0	0	0
Copper	0	0	2	2	n	n	13	13	8	8	0	n	5	5	0	0	n	n	24	24	4314	4314	17	17
Lead	0	0	0	2	0	n	0	10	0	4	0	13	0	14	0	0	0	2	0	15	36	5515	0	37
Mercury	0	n	0	6	0	n	0	n	0	n	0	n	0	n	0	n	0	n	NE	NE	0.06	179	0	n
Nickel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	10	273	0	0
Selenium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.59	0	0
Silver	0.32	10 m	0.32	10 m	0.32	10 m	0.32	10 m	0.32	10 m	0.32	10 m	0.32	10 m	0.32	10 m	0.32	10 m	0.32	10 m	2	26 m	0	10 m
Thallium	0	0m	0	0m	0	0m	0	0m	0	0m	0	0m	0	0m	0	0m	0	0m	0	0m	0	0m	0	0m
Zinc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	54	61	0	0
Organotins																								
Tributyltin	0	n	0	170	0	n	0	n	0	n	0.10	208	0	n	0	n	0	n	0	10	0	25	0	n
Inorganic/General Chemistry																								
Cyanide	n	n	11	11	11	11	11	11	11	11	47	47	11	11	11	11	6	6	1	1	26	26	6	6
PAH's																								
Acenaphthene	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fluoranthene	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m
Naphthalene	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m
Semi-Volatile Organic Compounds																								
Benzidine	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2-Chloronaphthalene	0	NS	0	NS	0	NS	0	NS	0	NS	0	NS	0	NS	0	NS	0	NS	0	NS	0	NS	0	NS
2-Chlorophenol	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Di-n-butyl phthalate	NS	0m	NS	0m	NS	0m	NS	0m	NS	0m	NS	0m	NS	0m	NS	0m	NS	0m	NS	0m	NS	0m	NS	0m
1,4-Dichlorobenzene	0	0m	0	0m	0	0m	0	0m	0	0m	0	0m	0	0m	0	0m	0	0m	0	0m	0	0m	0	0m
2,4-Dichlorophenol	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diethyl phthalate	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m
Hexachlorobutadiene	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4-Nitrophenol	0	0m	0	0m	0	0m	0	0m	0	0m	0	0m	0	0m	0	0m	0	0m	0	0m	0	0m	0	0m
N-Nitrosodiphenylamine	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m
Pentachlorophenol	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phenol	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chlorinated Pesticides																								
Aldrin	0	0m	0	0m	0	0m	0	0m	0	0m	0	0m	0	0m	0	0m	0	0m	0	0m	0	0m	0	0m

	DMMU3a		DMMU4/5b		DMMU6f		DMMU6g		DMMU6h		DMMU7c		DMMU7Ld		DMMU7Ne		DMMU9i		DMMU10j		DMMU10k		DMMU10L	
Contaminants	**Acute**	**Chronic**	**Acute**	**Chronic**	**Acute**	**Chronic**	**Acute**	**Chronic**	**Acute**	**Chronic**	**Acute**	**Chronic**	**Acute**	**Chronic**	**Acute**	**Chronic**	**Acute**	**Chronic**	**Acute**	**Chronic**	**Acute**	**Chronic**	**Acute**	**Chronic**
alpha-BHC	NS	0m	NS	0m	NS	0m	NS	0m	NS	0m	NS	0m	NS	0m	NS	0m	NS	0m	NS	0m	NS	0m	NS	0m
gamma-BHC (Lindane)	0	0m	0	0m	0	0m	0	0m	0	0m	0	0m	0	0m	0	0m	0	0m	0	0m	0	0m	0	0m
alpha-Chlordane	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0
gamma-Chlordane	0	4	0	0	0	n	0	0	0	0	0	112	0	2	0	0	0	0	0	0	0	0	0	n
4,4'-DDD	0	0	0	0	0	0	0	0	0	0.83	5	33	0	0	0	0	0	0	0	0.81	0	0.15	0	0.74
p,p'-DDE (4,4')	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m	0m
p,p'-DDT (4,4')	0	n	0	5	0	32	0	74	0	127	0	85	0	31	0	n	0	0	0	266	0	243	0	44
Dieldrin	0	7	0	0	0	0	0	2	0	0	0	160	0	0	0	0	0	7	0	0	0	0	0	5
Endosulfan I	0	0	0	0	0	0	0	0	0	0	0	0.51	0	0	0	0	0	0	0	0	0	0	0	0
Endosulfan II	0	0	0	0	0	0	0	0	0	0	0	0.51	0	0	0	0	0	0	0	0	0	0	0	0
Endosulfan sulfate	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Endrin	0	0	0	0.33	0	3	0	0	0	0	0	36	0	0	0	0	0	0	0	2	0	11	0	19
Heptachlor	0	n	n	n	0	0	0	n	0	n	0	n	0	0	0	0	0	0	0	0	0	n	0	0
Heptachlor epoxide	0	0	0	0	0	0	0	0	0	0	0	18	0	0	0	0	0	0	0	0	0	0	0	0
Methoxychlor	NS	0	NS	0	NS	0	NS	0.58	NS	0.18	NS	0	NS	0	NS	0	NS	0	NS	0	NS	0	NS	0
Toxaphene	0	n	0	n	0	n	0	n	0	n	0	85	0	n	0	n	0	n	0	n	0	n	0	n
PCBs																								
PCB Total	0	13	0	22	0	0	0	0	0	0	0	447	0	0	0	0	0	4	0	0	0	0	0	34
Max	0.32	13	11	170	11	32	13	74	11	127	47	447	11	31	11	11	6	10	24	266	4314	5515	17	44
Average	0.007519	0.89	0.31	5	0.26	1	0.57	3	0.44	4	1	31	0.36	2	0.26	0.52	0.15	0.74	0.66	8	103	250	0.53	4
Min	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

a DMMU 3 C1-3 Land, b DMMU 4/5N Comp 1&11, Sites 4, 5, 7, 8, 12 &13, c DMMU 7 Sites 2, 3, and 4, d DMMU 7Land Sites 5, 6, 7, 8 & 9, e DMMU 7N Comp 1-9, f DMMU 6 Site 1 and 2, g DMMU 6 Land Site 3, 4, 5, & 6, h DMMU 6N Sites 1, 2, 3, 4, 5 & 6, I DMMU 9 Comp 2&4, j DMMU 10 Land Comp 3 & 4, k DMMU 10N Comp 3 & 4, l DMMU 10 Site 1, m Based on EPA Region IV Water Quality Screening Criteria for Hazardous Waste Sites, n Background Exceeds WQC and Elutriate Concentrations

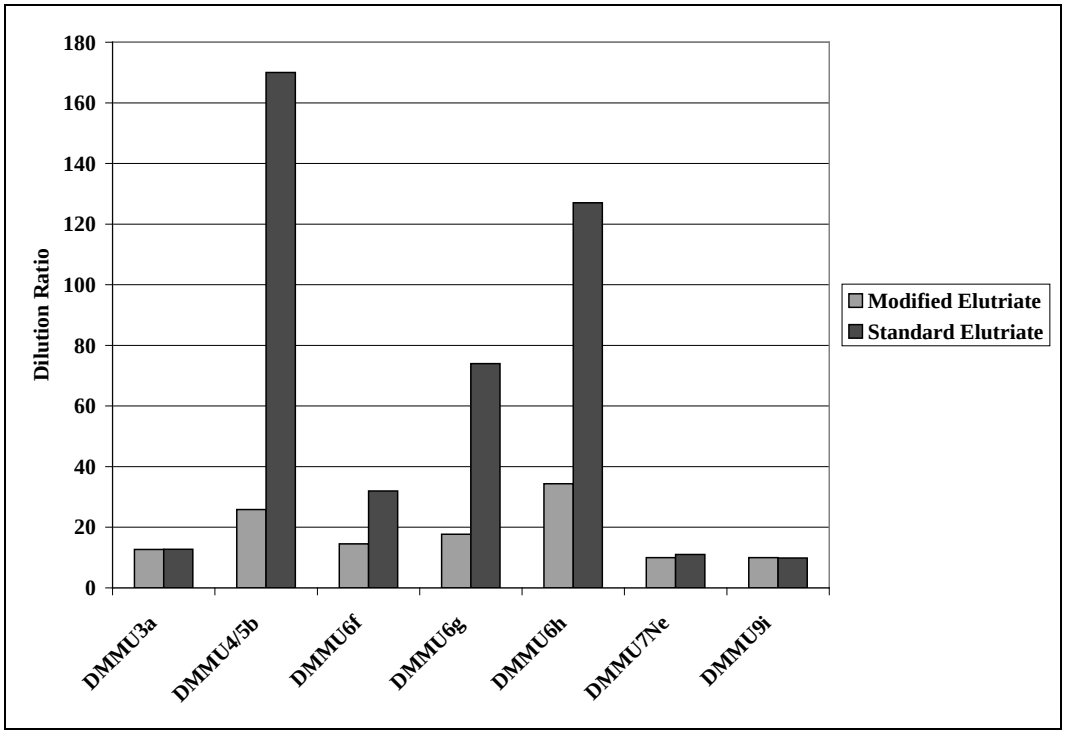

Figure 25. Maximum dilution ratios required to meet chronic criteria for selected DMMUs (see Table 37 footnotes for further explanation of site designations).

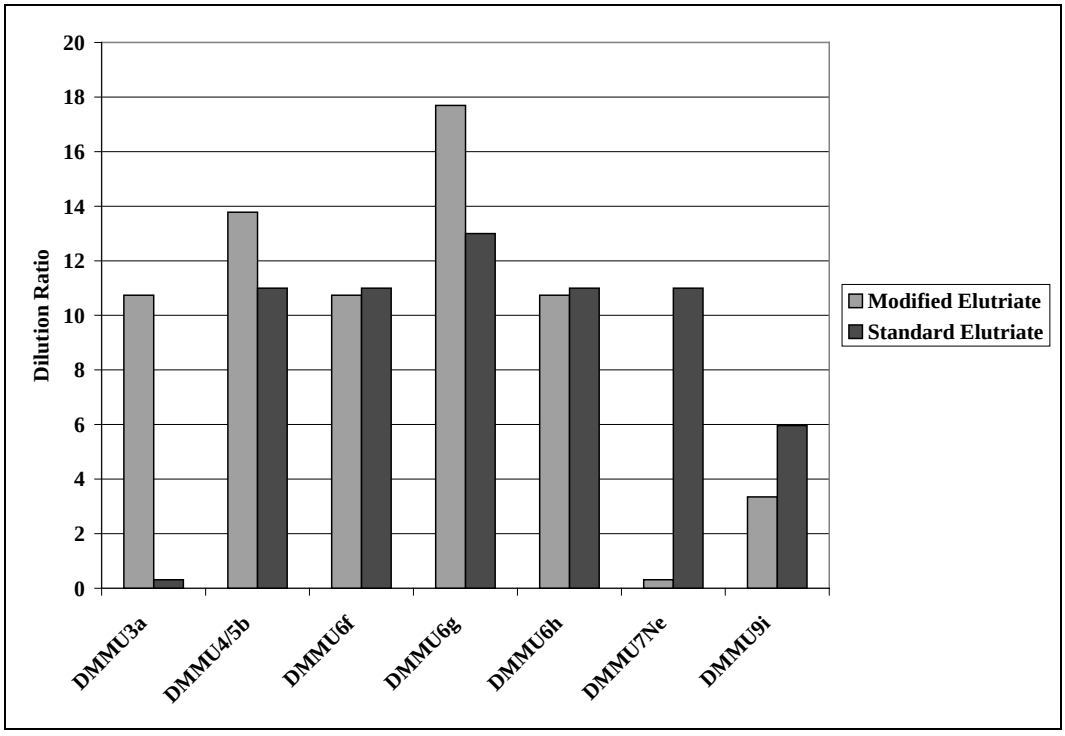

Figure 26. Maximum dilution ratios required to meet acute criteria for selected DMMUs (see Table 37 footnotes for further explanation of site designations).

Figure 27. Locations of tidal range measurements in area of mitigation site.

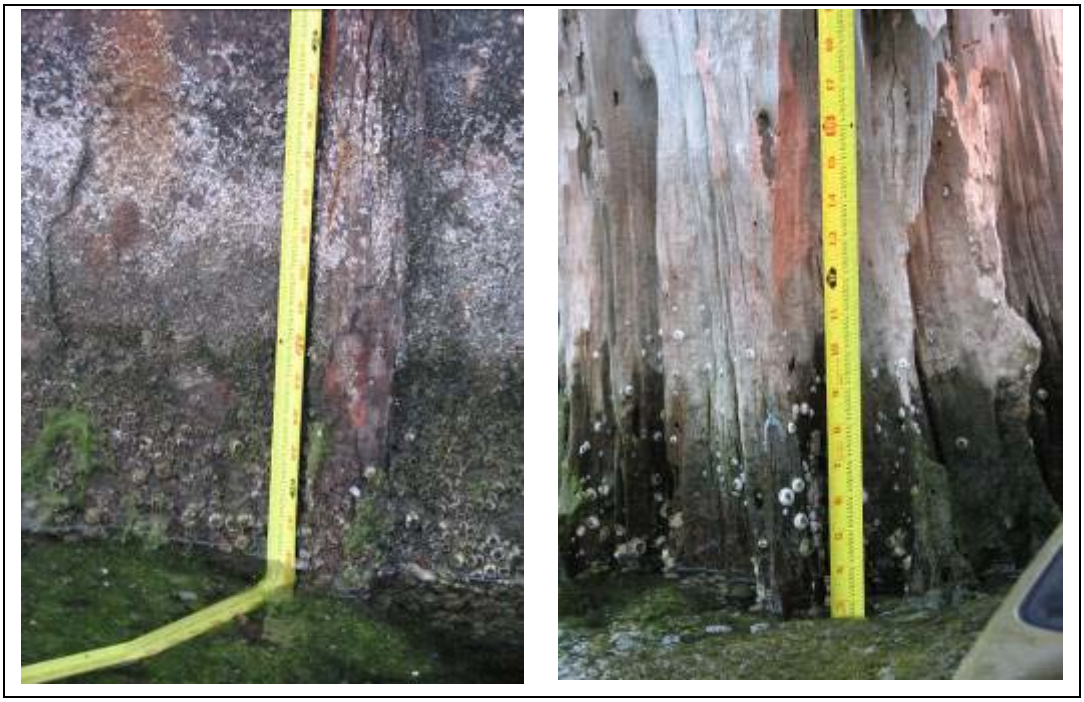

Figure 28. Tidal range measurements taken at wall (left) and stump (right) in area near proposed mitigation site.

A 24-in. hydraulic dredge is estimated to produce a slurry discharge of approximately 47.1 cfs. The dredge is assumed to operate 20 hr per day, which would produce an effective flow rate for a 24-hr period of approximately 39 cfs. Net inflow rate (the volumetric displacement rate) is estimated to be approximately 26 cfs, assuming about one third of the material storage will be above the water level (not displacing resident water) in this case. Given the estimated flow rate in the mitigation area of 111 cfs, this would yield an approximate dilution ratio of 4:1. This is insufficient to meet dilution requirements for acute or chronic criteria in most cases, in addition to requiring an area larger than that specified for either a zone of initial dilution or a mixing zone under LA water quality regulations. However, suspended phase toxicity testing conducted on the marine elutriates did not result in significant toxicity, even at full strength. If no other adverse effects are anticipated with the placement, and given the interest and benefit associated with restoration of the wetland, this may be sufficient justification for a waiver from water quality criteria for this action.

Additional consideration must be given to dilution of water leaving the triangular area and flowing into Bayou Bienvenue. Assuming effluent dilution of 4:1 occurs within the triangular area, dilution requirements in Bayou Bienvenue will be reduced somewhat. However, the combined flow from the dredge and the tidal exchange of the triangular area must now be considered as influent to Bayou Bienvenue. An average flow rate in Bayou Bienvenue was estimated assuming a discharge weir would be located at the northeastern-most corner of the triangular area, at which point the bayou is approximately 9000 ft in length. Assuming 130 ft width and a 1-ft tidal range results in an average flow rate within the bayou of 13.5 cfs. Periods of higher flow may be expected, as was previously stated. Based on combined dredge and tidal outflows from the mitigation area of 137 cfs and average flows in Bayou Bienvenue of 13.5 cfs, the estimated maximum attainable dilution in Bayou Bienvenue is <<1. This is insufficient to meet applicable water quality criteria in Bayou Bienvenue, and a waiver will be required for discharge to Bayou Bienvenue as well.

Potential recoverable area

The wetland area potentially recoverable was estimated based on the assumption that if material proposed for permanent storage in the CDF could be utilized as construction fill, fill materials (designated as such because of their suitability for placement in either freshwater or marine environments) could be utilized for additional wetland restoration instead.

The number of acres recoverable was estimated based on the relationship given in Hartman Engineering Inc. (2001), which takes into account wave height and water depth. (See USACE-ERDC (2008) for site- specific assumptions used in deriving the following equation.) Assuming the volume of the material after initial consolidation and desiccation has taken place, V_{fill} will be approximately 1.5 times that of the in situ sediment ($V_{in\text{-}situ}$):

$$A = \frac{V_{fill}}{d_{fill}} = \frac{1.5\,V_{in-situ}}{4.28 - 1.39x}$$

where:

$V_{in\text{-}situ}$ = in situ sediment volume available (acre*ft)
x = bottom elevation (ft)
d_{fill} = depth of fill (ft)

Estimates of total acreage recoverable are summarized in Table 39 and range from 37 acres to 319 acres for the two lock construction alternatives under consideration.

Conclusions

Based on estimates of dilution requirements based on standard and modified elutriates for selected DMMUs, available dilution in both the mitigation site and in Bayou Bienvenue are insufficient to meet water quality criteria during dredged material disposal. However, because none of the elutriates demonstrated toxicity in marine suspended phase toxicity tests, and because there is potentially significant environmental and community benefit associated with restoration of the wetland, a waiver may be justified. Potentially recoverable wetland area was estimated to range between 37 acres and 148 acres for the FIP construction alternative, and between 115 acres and 319 acres for the CIP construction alternative.

Table 39. Estimated restorable wetland area.

x (ft)	V_{Insitu} (yd^3)			
	253450[a]	570250[b]	789600[c]	1228900[d]
	Area (acres)			
0.5	65.7	148	205	319
0	55.1	124	172	267
-0.5	47.4	107	148	230
-1	41.6	93.5	129	202
-1.5	37.0	83.3	115	180

[a] FIP without fill volumes, [b] FIP with additional fill volumes, [c] CIP without fill volumes, [d] CIP with additional fill volumes

5 Benthic Toxicity Evaluation

Note that DMMUs 1 and 2 were not evaluated for benthic toxicity because Tier I evaluation (Appendix A) determined dredged material from those DMMUs as unsuitable for open water disposal.

Freshwater open water disposal evaluation

Dredged material is predicted to be acutely toxic to benthic organisms when the mortality of test organisms exposed to sediment from in-channel stations is statistically greater than the mortality of test organisms exposed to sediment from the reference area, and exceeds mortality of organisms exposed to sediment from the reference area by at least 20% when the test organisms are amphipods (10% is used for other recommended organisms).

A one-way Analysis of Variance (ANOVA; SPSS, Inc., Chicago, IL) was conducted to determine if statistically significant reductions relative to the control existed. Survival data were arc-sine square root transformed prior to analysis. Toxicologically significant amphipod mortality was defined as a statistically significant 20% reduction in survival relative to reference sediment (USEPA and USACE 1998).

Ten-day solid phase benthic toxicity tests using the amphipod *Hyalella azteca* were conducted in three batches (Weston Solutions 2008). Amphipod survival data are summarized in Table 40 and Figure 29. Mean survival in the control sediment for the three batches was high (85% or higher) and indicated that test conditions and health of the organisms were acceptable. Mean survival in the reference sediment was 85% or higher for all three batches (Table 41). Survival in dredged material was significantly lower than in the reference sediment only for non-native sediments from DMMU 5 and from DMMU 7 (Table 40).

The observed significantly higher mortality of *Hyalella azteca* in DMMUs 5 NN and 7 NN was, at least partially, a response to the relatively elevated concentration of metals in those channel sediments. A linear regression of mean percent mortality with the average ER-M quotient (see Section titled “Chemical Trends” on page 33) suggests a causal relationship between heavy metal concentration and decreased survival (Figure 30). A similar relationship with organic-carbon normalized sum-PAHs concentrations

Table 40. *Hyalella azteca* 10-day freshwater solid phase toxicity tests.

DMMU	Percent Survival			Batch
	Mean	Std. Dev	Statistical Comparison with Reference	
3 NN	91	8	Not different	1
3 N	95	8	Not different	1
3 F	93	7	Not different	1
4 NN	83	21	Not different	2
5 NN	60	33	Different	2
4/5 N	93	7	Not different	2
6 NN	90	9	Not different	1
6 N	95	5	Not different	2
6 F	95	8	Not different	3
7 NN	51	33	Different	2
7 N	89	8	Not different	2
7 F	95	8	Not different	3
8 NN	85	12	Not different	1
9-1 NN	91	15	Not different	3
9-2,4 NN	89	16	Not different	3
10 NN	91	10	Not different	2
10 N	86	14	Not different	3
10 F	80	33	Not different	3
Mean percent survival in exposure to IHNC dredged material samples and statistical comparison with mean survival in reference sediment sample.				

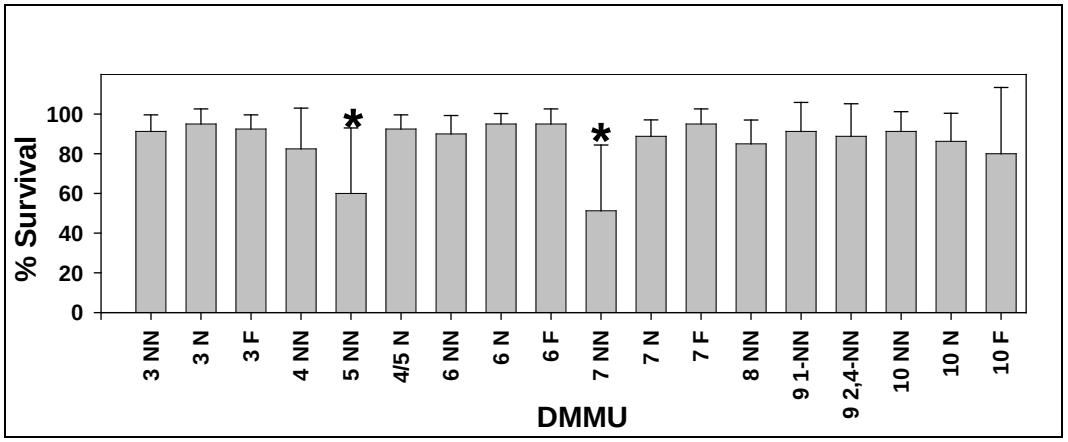

Figure 29. *Hyalella azteca* 10-day freshwater solid phase toxicity tests. Mean percent survival in exposures IHNC dredged material samples. * indicates statistically significant decreased survival.

Table 41. *Hyalella azteca* 10-day freshwater solid phase toxicity tests.

Batch	Percent Survival	
	Mean	Std. Dev
1	89	11
2	98	5
3	85	13

Mean percent survival in exposure to reference sediment for exposure batches 1, 2, and 3.

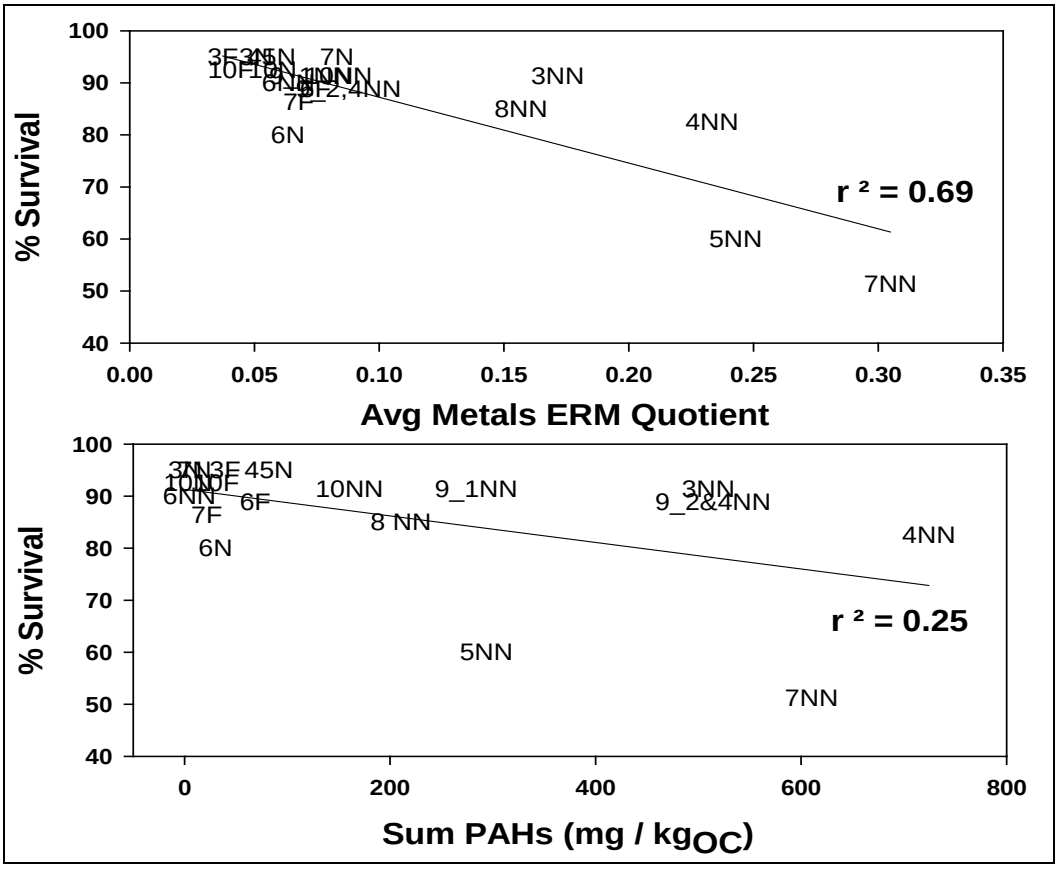

Figure 30. Benthic toxicity evaluation. Mean percent survival of *Hyalella azteca* exposed to IHNC dredged material. * indicates statistically significant decreased survival.

(Figure 30) yielded a much lower coefficient of determination ($r^2 = 0.25$), suggesting that those contaminants were present at sum concentrations too low to promote the observed mortality in non-native sediments from DMMUs 5 NN and 7 NN. Therefore, it is speculated that high concentrations of heavy metals in those DMMUs promoted the observed significant decrease in amphipod survival.

Based on the results of the solid phase toxicity tests, DMMUs 5 NN and 7 NN are predicted to be acutely toxic to freshwater benthic organisms. All remaining IHNC DMMUs are not predicted to be acutely toxic to freshwater benthic invertebrates.

Estuarine open water disposal evaluation

Ten-day solid phase benthic toxicity tests using the estuarine amphipod *Leptocheirus plumulosus* were conducted in three batches (Weston Solutions 2008). Amphipod survival data are summarized in Table 42 and Figure 31. Mean survival in the control sediment (94% or higher) indicated that test conditions and health of the organisms were acceptable for the three batches. Mean survival in the reference sediment was 82% or higher for all three batches (Table 43). A one-way Analysis of Variance (ANOVA; SPSS, Inc., Chicago, IL) was conducted to determine if statistically significant reductions relative to the control existed. Survival data were arc-sine square root transformed prior to analysis. Toxicologically significant amphipod mortality was defined as a statistically significant 20% reduction in survival relative to reference sediment (USEPA and USACE 1998). Survival in dredged material was significantly lower than in the reference sediment for non-native sediments and subsurface soil from DMMUs 3 NN, 3 N, 4 NN, 5 NN, 8 NN, and 9-1 NN (Table 42). Therefore, benthic toxicity is predicted for those dredged material samples.

The concentration of metals in channel sediments from DMMUs 3 NN, 4 NN, 5 NN, and 8 NN likely contributed to the relatively high mortality of *Leptocheirus plumulosus* in laboratory toxicity tests. A linear regression of mean metals ER-M quotient with mean percent mortality suggests a causal relationship between metals concentration and decreased survival (Figure 32). Elimination of DMMU 7 NN, where survival was high despite a relatively high metals ER-M quotient, from the analysis demonstrated a stronger linear relationship ($r^2 = 0.68$). The relationship between organic-carbon normalized total PAHs concentration (sum concentration of acenaphthene, acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(ghi)perylene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, dibenzofuran, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, and pyrene) and *L. plumulosus* survival (Figure 33) yielded a much lower coefficient of determination ($r^2 = 0.28$), suggesting that those contaminants were present at concentrations too low to significantly contribute to the observed high mortality.

Table 42. *Leptocheirus plumulosus* 10-day solid phase toxicity tests.

DMMU	Percent Survival			Batch
	Mean	Std. Dev	Statistical Comparison with Reference	
3 NN	42	13	Different	1
3 N	69	16	Different	1
3 F	75	10	Not different	1
4 NN	50	19	Different	2
5 NN	32	14	Different	2
4/5 N	67	10	Not different	2
6 NN	93	8	Not different	1
6 N	85	5	Not different	2
6 F	81	10	Not different	3
7 NN	80	14	Not different	2
7 N	86	12	Not different	2
7 F	90	6	Not different	3
8 NN	39	7	Different	1
9-1 NN	59	10	Different	3
9-2,4 NN	67	10	Not different	3
10 NN	89	7	Not different	2
10 N	82	9	Not different	3
10 F	92	3	Not different	3

Mean percent survival in exposure to IHNC dredged material samples and statistical comparison with mean survival in reference sediment sample.

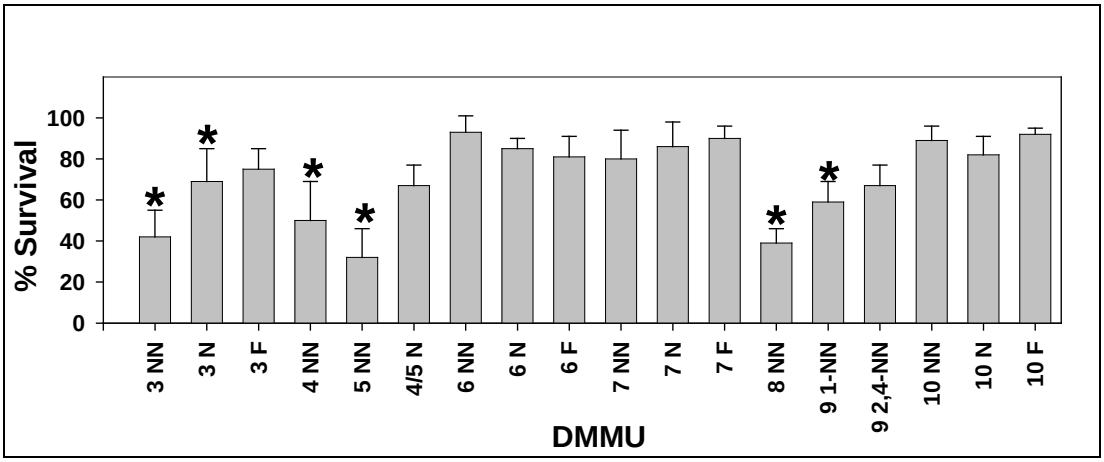

Figure 31. *Leptocheirus plumulosus* estuarine 10-day solid phase toxicity tests. Mean percent survival in exposures IHNC dredged material samples. * indicates statistically significant decreased survival.

Table 43. *Leptocheirus plumulosus* 10-day solid phase toxicity tests.

Batch	Percent Survival	
	Mean	Std. Dev
1	89	7
2	98	5
3	85	6

Mean percent survival in exposure to reference sediment for exposure batches 1, 2, and 3.

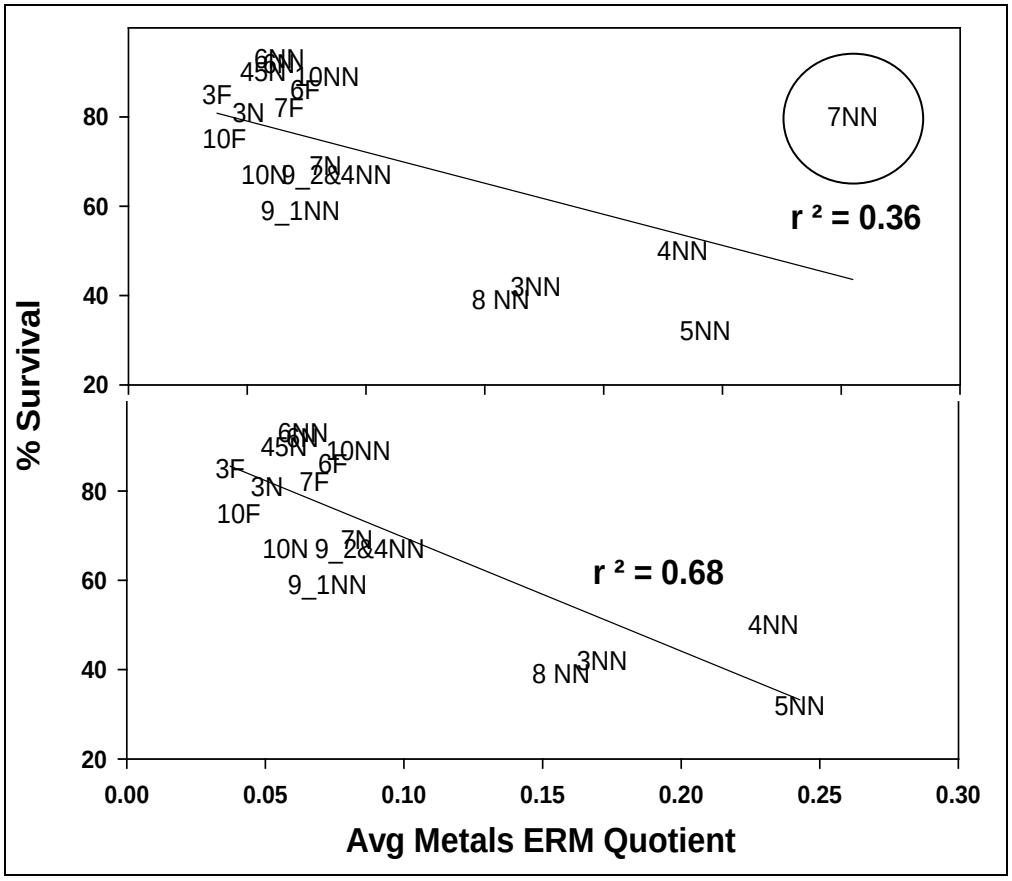

Figure 32. Benthic toxicity evaluation. Mean percent survival of *Leptocheirus plumulosus* exposed to IHNC dredged material as a function the average metals ERM quotient for all samples evaluated (top) and for sample 7 NN excluded from the regression (bottom).

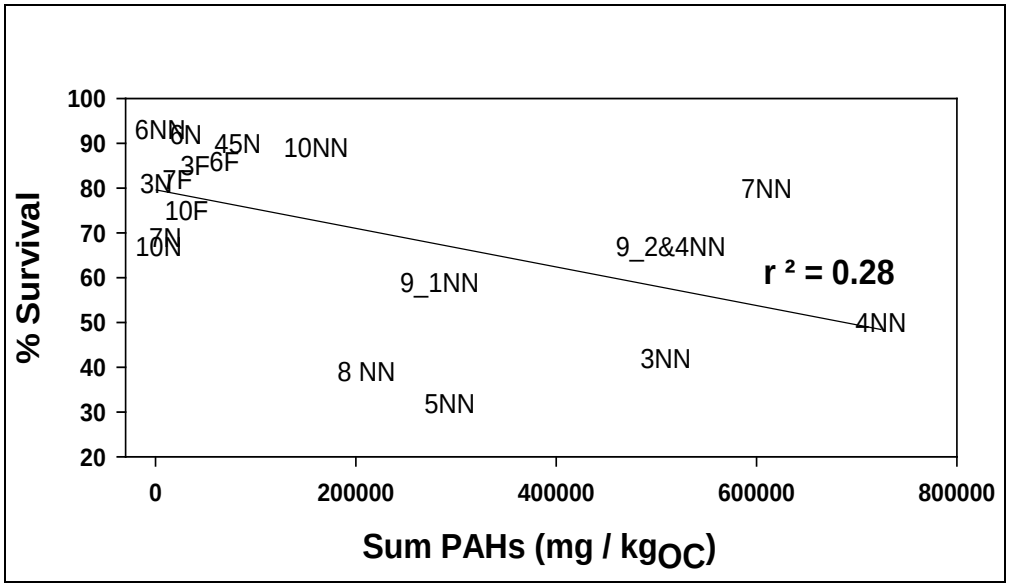

Figure 33. Benthic toxicity evaluation. Mean percent survival of *Leptocheirus plumulosus* exposed to IHNC dredged material samples as a function of organic-carbon normalized Sum PAHs concentrations.

Based on the results of the solid phase toxicity tests, dredged material from DMMUs 3 NN, 3 N, 4 NN, 5 NN, 8 NN, and 9-1 NN are predicted to be acutely toxic to estuarine benthic invertebrates. All remaining IHNC DMMUs are not predicted to be acutely toxic to estuarine benthic invertebrates.

6 Bioaccumulation Potential Evaluation

According to the ITM, data from bioaccumulation tests are evaluated at two levels. First, the amount of bioaccumulation of a specific contaminant in tissues exposed to dredged material is compared to applicable USFDA Action or Tolerance Levels for Poisonous or Deleterious Substances in Fish and Shellfish for Human Food, when such levels have been set for the particular contaminants. Comparison with state fish consumption advisories and guidelines is also recommended. If the tissue concentration of the contaminant is not less than the USFDA levels, the dredged material is predicted to result in benthic bioaccumulation, and there is the potential for the dredged material to have an "unacceptable adverse effect." The USFDA levels (http://www.foodsafety.gov/~lrd/fdaact.html) are based on human health as well as economic considerations, but do not indicate the potential for environmental impact on the contaminated organisms or the potential for biomagnification. Because contamination of food in excess of FDA levels is considered a threat to human health, concentrations in excess of such levels in any test species are considered to be predictive of benthic bioaccumulation of contaminants (USEPA/USACE 1998). This guidance applies even though the test species may not be a typical human food item partly because certain contaminants can be transferred through aquatic food webs, but mainly because uptake to USFDA levels in relatively short-term tests with one species may indicate the potential for accumulation in other species.

If the tissue concentration of the contaminant is less than the USFDA level or if there is no USFDA level for comparison, the contaminant concentration in tissues exposed to dredged material is compared to contaminant concentrations of tissues exposed to sediment from the reference area. If the tissue concentration of the contaminant in organisms exposed to dredged material does not statistically exceed the tissue concentration of the contaminant in organisms exposed to sediment from the reference area, the dredged material is not predicted to result in benthic bioaccumulation. If tissue concentrations of the contaminant in organisms exposed to dredged material statistically exceed those of organisms exposed to sediment from the reference area, the conclusion regarding benthic bioaccumulation is based on technical evaluations such as the following:

- The toxicological importance of the contaminant.
- The propensity for the contaminant to bioaccumulate in higher trophic levels within aquatic food webs.
- The magnitude by which bioaccumulation in tissues of organisms exposed to dredged material exceeds bioaccumulation in tissues of organisms exposed to sediment from the reference area.
- The number of contaminants for which bioaccumulation from the dredged material is statistically greater than bioaccumulation from sediment from the reference area.
- The magnitude by which the contaminant whose bioaccumulation from dredged material exceeds that from the reference area also exceeds the concentrations found in comparable species living in the vicinity of the proposed disposal area.

Freshwater bioaccumulation potential evaluation

Non-native sediments from DMMUs 5 and 7 (5 NN and 7 NN) were predicted to be acutely toxic to benthic organisms, and therefore unsuitable for open water disposal. Therefore, bioaccumulation data for those DMMUs were not further evaluated for bioaccumulation potential.

The clam *Corbicula fluminea* was used to conduct 28-day solid phase benthic bioaccumulation tests in four batches (Weston Solutions 2008). Mean survival in the control sediments (95% for all batches) indicated that test conditions and health of the organisms were acceptable for batches 2, 3, and 4. Survivorship in batch 1 was generally low (Table 44). Clams in batch 1 were received from a source in the state of Virginia. Those organisms were collected and held in water for 24 hr and then shipped overnight to ERDC with damp paper towels on ice. It is speculated that those holding and shipping methods stressed the organisms, leading to reduced survival in all batch 1 dredged material, including the reference, where mean survival was 62%. Clams from batches 2, 3, and 4 were collected from a different source, in the state of Arkansas, held in an artificial stream, and transported to ERDC the same day, submerged in water. Mean survival in the reference sediment was 98%, and overall survival was high for clams from Arkansas used in batches 2, 3, and 4 (Table 44).

Because of the onset of mortality during the 28-day exposure period, sufficient tissue for all chemical analyses could not be obtained from every replicate chamber. Therefore, analyses of hexavalent chromium, volatile

compounds, and organotins were not performed for most replicates. Analysis of Aroclors, semi-volatiles, and pesticides was not performed for a few of the total replicates (Table 45). The following prioritization sequence was developed to ensure that contaminants with greatest potential for bioaccumulation and toxicological relevance were analyzed.

1. Metals
2. Semi-volatile compounds, organochlorine pesticides, and PCBs
3. Organotins
4. Hexavalent chromium
5. Volative compounds

Table 44. *Corbicula fluminea* 28-day freshwater solid phase bioaccumulation tests.

DMMU/Site	Percent Survival		Final Biomass (g)		Batch
	Mean	Std. Dev	Mean	Std. Dev	
3 NN	95	4	27.5	2.9	2
3 N	96	3	23.2	2.4	2
3 F	64	5	17.5	2.2	1
4 NN	91	6	24.3	3.3	3
5 NN	94	4	22.2	2	4
4/5 N	58	4	13.9	1.9	4
6 NN	58	10	18.4	3.5	1
6 N	83	4	25.5	3.2	2
6 F	96	4	29.4	8.2	2
7 NN	53	7	17.5	2.9	1
7 N	85	6	24	7.7	3
7 F	93	7	22.8	6.2	2
8 NN	85	5	20.2	4.8	4
9-1 NN	89	7	23.6	3.2	3
9 2-NN	73	27	18.8	6.8	4
10 1-NN	38	6	14	1.6	1
10 N	58	19	13.4	3.5	3
10 F	37	8	9.2	3.2	4
MR	64	5	20.1	8.5	1
MR	98	2	26.2	5.6	2, 3 and 4

Mean percent survival and biomass in exposure dredged material from IHNC DMMUs and sediment from the Mississippi River reference site.

Table 45. *Corbicula fluminea* 28-day freshwater solid phase bioaccumulation tests.

DMMU/Site	Volatiles	Hexavalant Chromium	Organotins	Aroclors	Semi-volatiles and Pesticides
3 NN	1,2,3,4,5	1,2,3,5	5		
3 N	1,2,3,4,5	1,2,3,4,5	1,2,3,4		
3 F	1,2,3,4,5	1,2,3,4,5	1,2,3,4,5		
4 NN	1,2,4,5	1,2,4,5			
5 NN	1,2,3,4,5	1,2,4,5	2,3	1	
4/5 N	1,2,3,4,5	1,2,3,4,5	1,2,3,4,5	2,3,4,5	
6 NN	1,2,3,4,5	1,2,3,4,5	1,2,3,4,5		
6 N	1,2,3,4,5	1,3,4	3,4		
6 F	1,2,3,4,5	1,2,3,4,5	2,5		
7 NN	1,2,3,5	1,2,3,4,5	1,2,3,4,5		
7 N	1,2,3,4,5	2,3,4,5	3		
7 F	1,2,3,4,5	1,4,5	4,5		
8 NN	1,2,3,4,5	1,2,3,4,5	1,2,5	1	
9-1 NN	1,2,3,4,5	1,2,3,4	2,3,		
9-2,4 NN	1,3,4,5	1,2,3,4,5	1,4,5		
10 NN	1,2,3,4,5	1,2,3,4,5	2,3,4,5	3	
10 N	1,2,3,4,5	1,2,3,4,5	1,2,3,4,5	2,5	
10 F	1,2,3,4,5	1,2,3,4,5	1,3	1,3	1,3,5
MR	1,2,3,4,5	1,2,5	1,2,5		

Exposure replicates of dredged material from IHNC DMMUs and sediment from the Mississippi River reference site that were not analyzed for tissue concentration of select compounds or classes of compounds.

Whole-body chemical analysis of clams exposed to IHNC dredged material during the 28-day solid phase bioaccumulation tests revealed the presence of metals, organotins, organochorine pesticides, PCBs (measured as Aroclors), and semi-volatile compounds (Weston Solutions 2008). Tissues exposed to sediment from the reference area revealed the presence of metals, PCBs, and semi-volatile compounds (Weston Solutions 2008). Volatile compounds were only analyzed for DMMUs 4 NN and 7 NN. Those compounds did not bioaccumulate at detectable levels in the tissues of clams exposed to sediment from those dredged materials (Weston Solutions 2008).

Comparison with USFDA action levels and OEHHA fish contaminant goals

Concentrations of contaminants of concern in tissues of a benthic invertebrate (the freshwater clam *Corbicula fluminea*) following dredged material exposure were compared to applicable USFDA Action or

Tolerance, when such levels have been set for the contaminants of concern. Applicable USFDA Action Levels are only available for a few of the contaminants of concern (or mixture of compounds) that bioaccumulated at measurable levels in tissues of organisms exposed to sediment from the IHNC dredged material. The highest observed mean concentration of those compounds in the tissues of exposed clams adjusted to steady-state body residues, according to USEPA/USACE (1998), were over three orders of magnitude lower than the USFDA levels and not statistically different from those levels (Table 46).

Table 46. *Corbicula fluminea* 28-day freshwater solid phase bioaccumulation potential evaluation.

Compound	Body Residue (µg/kg)		
	USFDA	OEHHA	IHNC
Chlordane	300	100	0.12
DDT + DDE	5000	N.A.	0.10
DDT + DDD + DDE	N.A.	1600	0.26
Dieldrin + Aldrin	300	N.A.	<0.4
Dieldrin	N.A.	160	<0.4
Heptachlor + Heptachlor Epoxide	300	N.A.	<0.3
PCBs	N.A.	63	3.0*
Selenium	N.A.	7400	860

Comparison of highest estimated steady-state body residue measured for tissues of clams exposed to IHNC dredged material DMMUs with USFDA Action Levels and fish consumption guidelines developed by OEHHA. * reported as Total Aroclor concentration. N.A. = not available.

Concentrations of contaminants of concern in *Corbicula fluminea* were also compared with fish contaminant goals (FCGs) developed by The California Office of Environmental Health Hazard Assessment (OEHHA). FCGs were developed for seven contaminants (http://www.oehha.org/fish/gtlsv/crnr062708.html). Those values are estimates of contaminant levels in fish that pose no significant health risk to individuals consuming sport fish at a standard consumption rate of 8 oz. per week, prior to cooking, over a lifetime. The highest observed mean concentration of those compounds in the clams was over a factor of 60 lower than the FCGs and not statistically different from those goals (Table 46).

Statistical comparison with reference site bioaccumulation

Tissue concentrations of all contaminants either are statistically less than USFDA levels or OEHHA fish contaminant goals or there are no OEHHA

or USFDA levels for the contaminants for comparison. Therefore, the information was insufficient to reach a conclusion with respect to benthic bioaccumulation of contaminants. The IHNC dredged material was further evaluated for bioaccumulation potential by comparing tissue contaminant concentrations for organisms similarly exposed to reference sediment.

Statistically elevated tissue residue relative to the reference was detected for at least one contaminant of concern for all IHNC dredged material investigated for bioaccumulation potential (Table 47). The DMMU with the highest number of exceedences was DMMU 3 F, with 15 exceedances. The DMMU with the least number of exceedances was DMMU 3 N (Table 47).

For DMMU 3 (3NN, 3 N and 3 F), four metals, several SVOCs, four pesticides, and total Aroclors were significantly elevated. For DMMU 4 (4 NN), three metals, one pesticide, one organotin, and one Aroclor were significantly elevated. For DMMU 4/5 N, five metals were significantly elevated. For DMMU 6 (6 NN, 6 N and 6 F) four metals, one semi-volatile compound, one pesticide, and total Aroclors were significantly elevated. For DMMU 8 (8 NN), four metals, one semi-volatile compound, and two pesticides were significantly elevated. In DMMU 9 (9-1 and 9-2,4 NN), four metals, three semi-volatile compounds, one pesticide, and one Aroclor were significantly elevated. For DMMU 10 (10 NN, 10 N and 10 F), seven metals were significantly elevated (Table 47).

The mean body residues for compounds of concern that were significantly higher in clams exposed to IHNC dredged material relative to those in clams exposed to reference material are presented in Table 48. Mean body residues measured for the reference site are presented for comparison purposes.

Table 47. *Corbicula fluminea* 28-day freshwater solid phase bioaccumulation potential evaluation.

Analyte	Exceedance Factor															
	DMMU/Site															
	3NN	3N	3F	4NN	4/5 N	6NN	6N	6F	7N	7F	8NN	9-1NN	9-2,4NN	10NN	10N	10F
Aluminum		3			2	5	2		2		2			2	2	
Barium			4			4	3							3		
Chromium			2	1	2				1		1		1		1	2
Lead			2	1		3		2	2	2	2		2	2		1.4
Nickel					1	2									2	1.4
Selenium				1	1								1			1.3
Tin					6				7		5	7			7	
Tributyltin				40												
Aroclor 1248				3									9			
Aroclors (Total)			4			3										
4,4'-DDT			4													
4,4'-DDD	7		9	8		5					13		7			
4,4'-DDE			8								5					
alpha-Chlordane			10													
4-Methylphenol						5										
Diethyl phthalate													5			
Dibenzofuran			71													
Phenol			7													
Acenaphthene	4		10													
Anthracene	3		8													
Fluoranthene	27		11													
Phenanthrene	6		6								3	3				
Pyrene	16		11										2			

Exceedance factor for mean tissue body residue of clams exposed to IHNC dredge material DMMUs compared to body residues of clams exposed to reference material for compounds with statistically significant bioaccumulation. Numbers in bold indicate 10 times or higher difference.

Table 48. *Corbicula fluminea* 28-day freshwater solid phase bioaccumulation potential evaluation.

Analyte	DMMU/Site																
	3NN	3N	3F	4NN	4/5N	6NN	6N	6F	7N	7F	8NN	9-1	9-2,4	10NN	10N	10F	MR
	Metals (mg/kg wet weight)																
Aluminum		58.7			49.1	106.6	51.0		54.7		56.0			51.4	52.0		22.9
Barium			3.6			4.1	2.4							3.1			0.9
Chromium			0.5	0.5	0.6				0.4		0.4		0.4		0.4	0.6	0.3
Lead			0.2	0.1		0.2		0.2	0.1	0.2	0.2		0.1	0.1		0.1	0.1
Nickel					0.2	0.3									0.2	0.2	0.1
Selenium				0.7	0.8								0.8			0.9	0.6
Tin					1.4						1.3	1.8			1.7		0.3
	Organotins (µg/kg wet weight)																
Tributyltin				20.0					1.7								0.5
	Pesticides and Semi-volatiles (µg/kg lipids)																
Aroclor 1248				23									66				7
Aroclors (Total)			114			98											31
4,4'-DDT			3														0.7
4,4'-DDD	5		6	5		3					9		5				0.7
4,4'-DDE			7								5						1.0
α-Chlordane			7														0.7
4-Methylphenol						624											120
Diethyl phthalate													1902				373
Dibenzofuran			1130														16
Phenol			247														33
Acenaphthene	106		235														24
Anthracene	73		197														24
Fluoranthene	642		298														24
Phenanthrene	283		247									435					47
Pyrene	390		271										1032				24
Mean body residue in clams exposed to IHNC dredge material DMMUs for compounds with statistically significant bioaccumulation.																	

Ecological significance of benthic bioaccumulation

To make conclusions regarding benthic bioaccumulation, compounds that bioaccumulated in clams exposed to IHNC dredged material at concentrations significantly higher than in clams exposed to reference sediment (Table 47) were evaluated for their toxicological importance, propensity to bioaccumulate in benthic and higher trophic level organisms within aquatic food webs, and the magnitude by which bioaccumulation in tissues of organisms exposed to dredged material exceed bioaccumulation in tissues of organisms exposed to sediment from the reference area.

All compounds with significant exceedance (Table 49) have some overall toxicological importance due to their potential adverse impact to benthic invertebrates when present in the sediment at above threshold concentrations. However, not all those compounds have the same importance as bioaccumulative chemicals, as their propensity to transfer to upper trophic level species preying on benthic organisms that bioaccumulate those compounds from the sediment exposures varies. It has been suggested that organic chemicals with a log octanol/water partitioning coefficient (log K_{ow}) value of 4.2 or greater tend to bioaccumulate in aquatic receptors of concern (USEPA 2000). As a general rule, only inorganic compounds with a bioconcentration factor (BCF) of greater than 1000 tend to bioaccumulate at levels of concern (USEPA USACE 1998, USEPA 2000). A list of organic and inorganic contaminants of concern considered important bioaccumulative compounds developed for use in sediment assessments is presented in USEPA (2000). Based on the criteria above, Table 49 indicates whether compounds with significant exceedances in this evaluation are important bioaccumulative compounds. The ecological and human health significance of benthic bioaccumulation of 4-methylphenol, diethyl phthalate, phenol, chromium, aluminum, barium, and tin is low. In addition, the magnitude of exceedance of reference values was low (factor of 7 or lower). Therefore, the potential adverse bioaccumulative impacts by those compounds are not further discussed in this evaluation. Those compounds are ruled out as likely posing any potential detrimental ecological or human health effect to the disposal area.

Table 49. *Corbicula fluminea* 28-day freshwater solid phase bioaccumulation potential evaluation.

Compound	Partitioning Coefficient	Potential Concern as Bioaccumulative Compound	Highest Factor of Exceedance	Highest Body Residue	Estimated Highest Steady-state Body Residue
Organochorine Pesticides	**Log K_{ow}**			**(µg/kg lipids)**	**(µg/kg lipids)**
4,4'-DDD	6.0	Yes	13.0	9.3	18.7
4,4'-DDE	5.7	Yes	8.0	7.4	12.4
4,4'-DDT	5.7	Yes	4.0	3.0	5.0
alpha-Chlordane	6.0	Yes	10.0	6.9	13.8
Aroclors	Log K_{ow}				
Aroclor 1248	>6	Yes	9.0	65.9	219.7
Aroclors (Total)	>6	Yes	4.0	114.2	380.6
PAHs	**Log K_{ow}**				
Acenaphthene	3.9	Yes	9.8	234.9	234.9
Anthracene	4.3	Yes	8.2	197.4	197.4
Dibenzofuran	4.1	Yes	71.0	1,29.9	1129.9
Fluoranthene	5.5	Yes	26.8	642.5	642.5
Phenanthrene	4.5	Yes	6.3	435.0	435.0
Pyrene	4.9	Yes	16.3	1,031.7	1146.3
Total PAHs		Yes	12.0	10,449.6	13062.0
Other Semi-volatiles	**Log K_{ow}**				
4-Methylphenol	2.0	No	5.0	624.0	624.0
Diethyl phthalate	1.4	No	5.0	1902.5	1902.5
Phenol	1.5	No	7.0	246.9	246.9
Organotin	Log K_{ow}			(µg/kg)	(µg/kg)
Tributyltin	3.7	Yes	40.0	20.0	20.0
Metals	Log BCF			(mg/kg)	(mg/kg)
Aluminum	< 2.5	No	3.0	106.64	106.6
Barium	2.1	No	4.0	4.10	4.1
Chromium	2.1	No	2.0	0.60	0.6
Lead	2.2	Yes	2.0	0.23	0.2
Nickel	1.7	Yes	2.0	0.31	0.3
Selenium	2.5	Yes	1.3	0.86	0.9
Tin	3.5	No	7.0	1.84	1.8

List of compounds significantly higher in IHNC dredged material DMMUs than in reference sediment, their associated partitioning coefficient (Log K_{ow} or Log BCF), potential concern as bioaccumulative compounds, and highest measured mean factor of exceedance, body residue and estimated steady-state body residue.

The tissue concentrations of nickel and selenium in clams exposed to channel sediments exceed the concentration of those metals in clams exposed to reference sediment by factors of 2.0 and 1.3, respectively

(Table 49). Despite their relatively high importance as bioaccumulative compounds, such low magnitude of difference in bioaccumulation levels suggests that the toxicological relevance of the measured statistical significant differences is negligible and does not warrant further examination of the ecological significance. Nickel and selenium are also ruled out as likely of posing any potential detrimental ecological or human health effect to the disposal area.

The bioaccumulation of 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, alpha-chlordane, Aroclor 1248, Aroclors (total), acenaphthene, anthracene, dibenzofuran, fluoranthene, phenanthrene, pyrene, tributyltin are not ruled out as potentially posing detrimental ecological effect to the Mississippi River disposal and are therefore further evaluated.

Bioaccumulation of PAHs

Potential ecological effects of the bioaccumulation of the PAHs anthracene, fluoranthene, phenanthrene, pyrene, and dibenzofuran were evaluated by direct comparison of total PAH tissue residues (sum concentration of acenaphthene, acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(ghi)perylene, benzo(k)-fluoranthene, chrysene, dibenzo(a,h)anthracene, dibenzofuran, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, and pyrene) from clams exposed to sediment from each IHNC dredged material with the critical body residue (CBR) for nonpolar organic chemicals as described by McCarty et al. (1992). The CBR is the whole body molar concentration of a chemical that is associated with a given adverse biological response (Rand et al. 1995), *i.e.*, the ratio of number of molecules of the chemical/toxicant to the mass of the organism, above which adverse effects have been observed to occur. The acknowledged mode of toxicity for PAHs is general narcosis. According to McCarty et al. (1992), CBRs of PAHs ranging from 2,000 to 8,000 µmol/kg produce acute narcotic response, and CBRs of PAHs ranging from 200 to 800 µmol/kg are predicted to produce chronic narcotic response.

The total PAH level in tissues from clams in DMMUs evaluated for bioaccumulation potential ranged from 2 µmol/kg lipid to 67 µmol/kg lipid (Table 50), after adjusting to estimated steady state. Using a lipid content of 1% for the freshwater clams used in the freshwater evaluation, the highest value is 400 times less than the levels at which chronic

narcotic effects might be expected and 4,000 times less than the levels at which acute narcotic effects might be expected.

Table 50. *Corbicula fluminea* 28-day freshwater solid phase bioaccumulation tests.

DMMU/Site	Total PAHs (µmol/kg lipids)
3 NN	17
3 N	7
3 F	43
4 NN	54
4/5 N	58
6 NN	4
6 N	3
6 F	6
7 N	57
7 F	3
8 NN	61
9-1 NN	59
9-2,4 NN	67
10 NN	2
10 N	51
10 F	43
MR	43
Estimated mean total PAH steady-state body residue in clams exposed to dredged material from IHNC DMMUs and sediment from the Mississippi River reference site.	

Potential ecological effects of the bioaccumulation of PAHs were further evaluated by comparing the total PAH level in tissues from clams exposed to IHNC dredged material to Narcosis Final Chronic Values (FCV) developed using the target lipid model (DiToro et al. 2000). The FAV is the concentration of chemical, based on experimental data, that will not (based on probability) have an acute narcotic effect on 95% of the organisms. Therefore, that value is protective of 95% of all species. The body residue in the tissues of the clams exposed to sediment from each IHNC dredged material evaluated was compared to the Narcosis FCV for PAHs (3,790 µmol/kg lipids). The highest mean sum PAH body residue (54 µmol/kg lipids) represents only 1.29% of the Narcosis FCV derived using the target lipid model.

Based on this evaluation, PAHs are ruled out as posing likely adverse ecological effect to the disposal area.

Bioaccumulation of Aroclors, 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT and alpha-chlordane

The bioaccumulation of compounds with significant exceedance and a difference from the reference higher than a factor of two was evaluated for their potential to cause toxic effects in the benthos and their potential to bioaccumulate and cause toxic effects in predator pelagic freshwater fish. Information on the relationship between body residues and effects was obtained from the Environmental Residue Effects Database (ERED) (http:www.wes.army.mil/el/ered).

Aroclor

The highest body residues for Aroclor Total were 381 µg/kg lipids or 3.81 µg/kg wet weight using 1% lipid content and adjusting to steady state. This concentration is over two orders of magnitude lower than no-observed-effect residue for a variety of freshwater invertebrates (1,200; 7,800; 1,400 µg/kg for midges, amphipods, and stoneflies, respectively). Lethal concentrations were not obtained for freshwater invertebrates. Therefore, the bioaccumulation of PCBs is not expected to result in adverse toxic effects to freshwater benthic invertebrates at the disposal site.

PCBs have high potential to transfer from prey invertebrates to predator fish through the dietary pathway. The lowest-observed-effect residue for freshwater fish was 1,530 µg/kg, reported for lake trout. This is the highest concentration of Aroclor in freshwater clams evaluated for bioaccumulation by two orders of magnitude. Therefore, even if the concentration of PCBs in fish is biomagnified by a factor of 10, body residues are substantially lower than any reported critical body residues and are not expected to result in adverse toxic effects to fish preying on freshwater benthic invertebrates at the disposal site.

4,4'-DDD

The highest body residues for 4,4'-DDD were 18.7 µg/kg lipids or 0.187 µg/kg wet weight using 1% lipid content and adjusting to steady state. This concentration is over four orders of magnitude lower than no-observed-effect residue (6,400 µg/kg) for a sensitive freshwater inverte-

brate, *Hyalella azteca*. The reported lethal tissue residues for that species are 12,800 µg/kg. Therefore, the bioaccumulation of DDD is not expected to result in adverse toxic effects to freshwater benthic invertebrates at the disposal site.

DDD has high potential to transfer from prey invertebrates to predator fish through the dietary pathway. The lowest-no-effect residue for freshwater fish was 5,000 µg/kg, reported for lake trout. This is the highest concentration of DDD in freshwater clams evaluated for bioaccumulation by four orders of magnitude. Therefore, even if the concentration of DDD in fish is biomagnified by a factor of 10, body residues are substantially lower than any reported critical body residues and are not expected to result in adverse toxic effects to fish preying on freshwater benthic invertebrates at the disposal site.

4,4'-DDE

The highest body residues for 4,4'-DDE were 12.4 µg/kg lipids or 0.124 µg/kg wet weight using 1% lipid content and adjusting to steady state. This concentration is six orders of magnitude lower than no-observed-effect residue (160,000 µg/kg) for a sensitive freshwater invertebrate, *Hyalella azteca*. The reported lethal tissue residues for that species are 320,000 µg/kg. Therefore, the bioaccumulation of DDE is not expected to result in adverse toxic effects to freshwater benthic invertebrates at the disposal site.

DDE has high potential to transfer from prey invertebrates to predator fish through the dietary pathway. The lowest-no-effect residue (whole body) for freshwater fish was 2,680 µg/kg, reported for lake trout. This is the highest concentration of DDE in freshwater clams evaluated for bioaccumulation by four orders of magnitude. Therefore, even if the concentration of DDE in fish is biomagnified by a factor of 10, body residues are substantially lower than any reported critical body residues and are not expected to result in adverse toxic effects to fish preying on freshwater benthic invertebrates at the disposal site.

4,4'-DDT

The highest body residues for 4,4'-DDT were 5.0 µg/kg lipids or 0.050 µg/kg wet weight using 1% lipid content and adjusting for steady state. This concentration is four orders of magnitude lower than no-

observed-effect residue (320 µg/kg) for a sensitive freshwater invertebrate, *Hyalella azteca*. The reported lethal tissue residues for that species are 640 µg/kg. Therefore, the bioaccumulation of DDT is not expected to result in adverse toxic effects to freshwater benthic invertebrates at the disposal site.

DDT has high potential to transfer from prey invertebrates to predator fish through the dietary pathway. The lowest-no-effect residue (whole body) for freshwater fish was 180 µg/kg, reported for rainbow trout. This is the highest concentration of DDT in freshwater clams evaluated for bioaccumulation by three orders of magnitude. Therefore, even if the concentration of DDT in fish is biomagnified by a factor of 10, body residues are substantially lower than any reported critical body residues and are not expected to result in adverse toxic effects to fish preying on freshwater benthic invertebrates at the disposal site.

Alpha-chlordane

The highest body residues for alpha-chlordane were 13.8 µg/kg lipids or 0.138 µg/kg wet weight using 1% lipid content and adjusting for steady state. This concentration is three orders of magnitude lower than no-observed-effect residue (4,500 µg/kg) for marine invertebrate, the oyster *Crassostrea virginica*. Critical body residue for alpha-chlordane is not available for freshwater invertebrate species. The bioaccumulation of alpha-chlordane is not expected to result in adverse toxic effects to freshwater benthic invertebrates at the disposal site.

Alpha-chlordane has high potential to transfer from prey invertebrates to predator fish through the dietary pathway. The lowest-observed-effect residue (whole body) for an estuarine fish was 1,380 µg/kg, reported for sheepshead minnow. This is the highest concentration of alpha-chlordane in freshwater clams evaluated for bioaccumulation by three orders of magnitude. Critical body residue for alpha-chlordane is not available for freshwater fish species. Even if the concentration of alpha-chlordane in fish is biomagnified by a factor of 10, body residues are substantially lower than any reported critical body residues and are not expected to result in adverse toxic effects to fish preying on freshwater benthic invertebrates at the disposal site.

Bioaccumulation of tributyltin

The concentrations of tributyltin were not measured in DMMUs 3F, 4/5 N, 6 NN, 7 NN, 8 NN, 10 NN, 10 N, and 10 F due to shortage of tissue mass (Table 51). Except for DMMU 4 NN, the concentration of that compound in the dredged material in the clams exposed to dredged material evaluated for bioaccumulation was below detection limit. The highest measured concentration in dredged material used in bioaccumulation evaluation, 19 µg/kg, was measured for DMMU 4 NN (Table 51). The mean tissue residue in clams exposed to that sediment was 20 µg/kg (Table 51). Therefore, tissue concentration of tributyltin in clams was expected to be 20 µg/kg or less for all DMMUs evaluated for bioaccumulation potential. The body residue of 20 µg/kg is 20 lower than lowest-observed-effect residue (480 µg/kg) for a marine invertebrate, the polychaete *Armandia brevis*. Critical body residue for tributyltin is not available for freshwater invertebrate species. The bioaccumulation of tributyltin is not expected to result in adverse toxic effects to freshwater benthic invertebrates at the Mississippi River disposal site.

Tributyltin has some potential to transfer from prey invertebrates to predator fish through the dietary pathway. The lowest-observed-effect residue (whole body) for freshwater fish was 400 µg/kg, reported for rainbow trout, *Oncorhynchus mykiss*. This concentration is 20 times higher than the concentration of tributyltin in freshwater clams evaluated for bioaccumulation. Assuming the concentration of tributyltin in fish is the same as in prey invertebrates, body residues are substantially lower than the lowest reported critical body residues and are not expected to result in adverse toxic effects to fish preying on freshwater benthic invertebrates at the disposal site.

Conclusions

Tissue concentrations of all contaminants for DMMUs not predicted to be toxic to benthic organisms were either statistically less than USFDA action levels or there are no USFDA levels for the contaminants. For those DMMUs, tissue concentrations of contaminants of concern in organisms exposed to dredged material statistically exceeded those of organisms exposed to the reference material. However, the IHNC DMMUs evaluated for bioaccumulation potential are not predicted to be toxic to benthic organisms and are not likely to have an unacceptable adverse effect on

survival, growth, or reproduction of aquatic organisms due to bioaccumulation.

Table 51. *Corbicula fluminea* 28-day freshwater solid phase bioaccumulation tests.

Sample	Sediment (µg/kg)	Tissue (µg/kg)
3 NN	2.3 U	1.2 U
3 N	2.5 U	1.2 U
3 F	1.9 U	ND
4 NN	19	20
5 NN	5.5	7
4,5 N	2.2 U	ND
6 NN	2.5 U	ND
6 N	2.6 U	1.2 U
6 F	2.3 U	1.2 U
7 NN	4.4	ND
7 N	2.1 U	1.2 U
7 F	2.1 U	1.2 U
8 NN	2.1 U	ND
9-1 NN	2.5 U	1.2 U
9-2,4 NN	2.6 U	1.2 U
10 NN	1.7 U	ND
10 N	2.3 U	ND
10 F	2.1 U	ND
MR	2.3 U	1.2 U

Mean total concentration of tributyltin in the tissues of clams exposed to dredged material from IHNC DMMUs and sediment from the Mississippi River reference site and concentration of those compounds in DMMUs dredged material and reference sediment. Values accompanied by "U" are reporting limits for not detected by chemical analysis. ND – concentration not determined due to shortage of tissue mass.

Estuarine open water disposal evaluation

According to the conclusions of the benthic toxicity evaluation, DMMUs 3N, 4NN, 5NN, 8NN, and 9-1 NN were excluded from the bioaccumulation evaluation as they are predicted to be acutely toxic to estuarine benthic invertebrates. In addition, conclusions from the water column evaluation determined that DMMUs 3 N, 6 NN, 6 N, 6 F, 7 NN, 7 F, 10 NN, 10 N and 10 F are not considered for disposal at the mitigation site. Therefore, only

bioaccumulation data from DMMU 9-2,4 N, 3 F, 4/5 N, and 7 N were evaluated for bioaccumulation potential at the mitigation site disposal area.

Twenty-eight-day solid phase benthic bioaccumulation tests using the clam, Macoma nasuta, were conducted in four batches (Weston Solutions 2008). Mean survival in the control sediments (80% and higher) indicated that test conditions and health of the organisms were acceptable for batches 1, 2, and 3. Mean survival in the reference sediment was 78% and higher (Table 52). Low survival (below 80%) observed in DMMUs 4/5 N and 9-2,4 NN was likely caused by non-contaminant factors.

Table 52. *Macoma nasuta* 28-day estuarine solid phase bioaccumulation tests.

	Percent Survival		
Sample	Mean	Std. Dev	Batch
3 F	89	8.4	1
4/5 N	43	15.3	3
7 N	86	10.6	2
9-2,4 NN	69.0	15.7	3
MIT	92.0	5.1	1
SB	90.0	6.7	1
SB	89.0	6.4	2
SB	78.0	6.1	3

Mean percent survival and biomass in exposure to dredged material from IHNC DMMUs and sediment from the San Bernard reference site and mitigation site.

Because of the onset of clam mortality during the 28-day exposure period, sufficient tissue for all chemical analyses could not be obtained from every replicate chamber for DMMUs 3 F, 4/5 N, 7 N, and 9-2,4 N, as well as for the mitigation site. Therefore organotins were not analyzed for most replicates, and semi-volatiles and hexavalent chromium were not analyzed for one the replicates from each DMMU (Table 53).

Whole-body chemical analysis of clams exposed to dredged material from DMMUs 3 F, 4/5 N, 7 N, and 9-2,4 N and to the mitigation site sediment during the 28-day solid phase bioaccumulation tests revealed the presence of metals, organochorine pesticides, PCBs (measured as Aroclors), semi-volatile compounds, and volatile compounds (Weston Solutions 2008). Tissues exposed to sediment from the reference area revealed the presence

of metals, organotins, PCBs, and semi-volatile compounds (Weston Solutions, Inc. 2008).

Table 53. *Macoma nasuta* 28-day estuarine solid phase bioaccumulation tests.

Sample	Organotins	Volatiles	Hexavalant Chromium
3 F			
4/5 N	1,3,4	1,3,4	1
7 N			
9-2,4 NN			
MIT		5	
SB - 1			
SB - 2			
SB - 3	5		

Exposure replicates of dredged material from IHNC DMMUs and sediment from the San Bernard reference site and mitigation site that were not analyzed for tissue concentration of select compounds or classes of compounds.

Comparison with USFDA action levels and OEHHA fish contaminant goals

The benthic bioaccumulation evaluation revealed that tissue concentrations of all COC for DMMUs evaluated for bioaccumulation potential were substantially lower and statistically different than all available USFDA action levels and FCGs developed by OEHHA (Table 54). For contaminants with USFDA action levels, body burden in clams exposed to dredged material were lower than reported action levels by over three orders of magnitude.

Because there is no USFDA level for comparison of most compounds found in the tissue of IHNC dredged material, the contaminant concentration in tissues exposed to dredged material was compared to contaminant concentrations of tissues exposed to sediment from the reference area.

Statistical comparison with reference site bioaccumulation

Statistically elevated tissue residue relative to the reference was detected for at least one contaminant of concern for all DMMUs investigated for bioaccumulation potential, except for DMMU 6 N (Table 55). The DMMU

with the highest number of exceedences was DMMU 7 N, with 10 exceedances.

Table 54. *Macoma nasuta* 28-day estuarine solid phase bioaccumulation evaluation.

	Body Residue (µg/kg)		
Compound	USFDA	OEHHA	IHNC
Chlordane	300	100	0.02
DDT + DDE	5000		0.02
DDT + DDD + DDE		1600	0.04
Dieldrin + Aldrin	300		<0.2
Dieldrin		160	<0.2
Heptachlor + Heptachlor Epoxide	300		0.4
PCBs		63	< 0.18*
Selenium		7400	800

Comparison of highest estimated steady-state body residue measured for tissues of clams exposed to dredged material from IHNC DMMUs with USFDA Action Levels and fish consumption guidelines developed by OEHHA.

* reported as Total Aroclor concentration.

For fill material from DMMU 3 (3F), three metals were significantly elevated. For native soil from DMMU 7 (7N), one metal, four pesticides, and five semi-volatile compounds were significantly elevated. For non-native sediment from DMMU 9 (9-2,4 NN), one metal, three pesticides and three semi-volatile compounds were significantly elevated. No significantly elevated bioaccumulation was determined for native soil from DMMUs 4 and 5 (4/5N). For non-native sediment from the mitigation site, two metals were significantly elevated (Table 55).

The mean body residues for compounds of concern that were significantly higher in clams exposed to a DMMU dredged material relative to those in clams exposed to reference sediment are presented in Table 56.

Ecological significance of benthic bioaccumulation

To make conclusions regarding benthic bioaccumulation, compounds that bioaccumulated in clams exposed to IHNC dredged material at concentrations significantly higher than in clams exposed to reference sediment (Table 57) were evaluated for their toxicological importance, propensity to bioaccumulate in benthic and higher trophic level organisms within aquatic food webs, and the magnitude by which bioaccumulation in tissues

of organisms exposed to dredged material exceed bioaccumulation in tissues of organisms exposed to sediment from the reference area.

Table 55. *Macoma nasuta* 28-day estuarine solid phase bioaccumulation tests.

	Exceedance Factor				
	DMMU/Site				
Analyte	3 F	4/5 N	7 N	9-2,4 NN	MIT
Aluminum	3				
Barium	3			4	3
Lead	2		1		5
4,4'-DDT			5		
delta-BHC			3		
Dieldrin			4	4	
Endosulfan II				3	
Heptachlor epoxide			6	8	
1,4-Dichlorobenzene			3		
4-Methylphenol			4		
Dibenzofuran			3		
Fluoranthene				11	
Fluorene			20		
Phenanthrene			2	3	
Pyrene				11	

Exceedance factor for mean tissue body residue of clams exposed to dredged material from IHNC DMMUs and mitigation site sediment compared to body residues of clams exposed to sediment from the San Bernard reference site for compounds with statistically significant bioaccumulation. Numbers in bold indicate 10 times or higher difference.

All compounds with significant exceedances (Table 57) have some overall toxicological importance due to their potential adverse impact to benthic invertebrates when present in the sediment at above threshold concentrations. However, not all those compounds have the same importance as bioaccumulative chemicals, as their propensity to transfer to upper trophic level species preying on benthic organisms that bioaccumulate those compounds from the sediment exposures varies. Based on criteria stated in the freshwater benthic bioaccumulation evaluation section, Table 57 indicates whether compounds with significant exceedances in this evaluation are important bioaccumulative compounds.

Table 56. *Macoma nasuta* 28-day estuarine solid phase bioaccumulation tests.

Analyte	Mean Body Residue DMMU/Site 3 F	4/5 N	7 N	9-2,4 NN	MIT
Metals (mg/kg wet weight)					
Aluminum	59.2				
Barium	1.2			1.8	1.3
Lead	0.4		0.4		1.1
Pesticides and Semi-volatiles (µg/kg lipids)					
4,4'-DDT			4.0		
delta-BHC			15.6		
Dieldrin			3.6	4.3	
Endosulfan II				25.6	
Heptachlor epoxide			5.7	8.0	
1,4-Dichlorobenzene			142.7		
4-Methylphenol			164.5		
Dibenzofuran			578.5		
Fluoranthene				393.1	
Fluorene			571.5		
Phenanthrene			603.3	84.5	
Pyrene				385.9	

Mean body residue in clams exposed to dredged material from IHNC DMMUs and mitigation site sediment for compounds with statistically elevated bioaccumulation.

The ecological and human health significance of benthic bioaccumulation of the semivolatiles 1,4-dichlorobenzene and 4-methylphenol is considered low. In addition, the magnitude of exceedance of reference values was low (factor of 4 or lower) for those compounds.

For metals, the observed bioaccumulation of aluminum (maximum exceedance = 3) and barium (maximum exceedance = 4) have low ecological significance, as these compounds are not likely to bioaccumulate in higher trophic levels. The tissue concentrations of lead in clams exposed to channel sediments exceed the concentration of that metal in clams exposed to reference sediment by a factor of 2.0 (Table 57). Despite its relatively high importance as a bioaccumulative compound, such low magnitude of difference in bioaccumulation levels suggests that the toxicological relevance of the measured statistical significant difference is negligible and does not warrant further examination of the ecological

Table 57. *Macoma nasuta* 28-day estuarine solid phase bioaccumulation potential evaluation.

Compound	Partitioning coefficient	Potential concern as bioaccumulative compound	Maximum factor of exceedance	Highest body residue	Estimated highest steady-state body residue
Organochorine Pesticides	**Log K_{ow}**				
4,4'-DDT	6.0	Yes	5	4.0	8.0
delta-BHC	3.8	Yes	3	15.6	15.6
Dieldrin	5.5	Yes	4	4.3	5.4
Endosulfan II	4.5	Yes	3	25.6	25.6
Heptachlor epoxide	5.4	Yes	8	8.0	10.0
PAHs	**Log K_{ow}**				
Dibenzofuran	4.1	Yes	3	578.5	578.5
Fluoranthene	5.5	Yes	11	393.1	491.4
Fluorene	4.2	Yes	20	571.5	571.5
Phenanthrene	4.5	Yes	3	603.3	603.3
Pyrene	4.9	Yes	11	385.9	428.8
Other Semi-volatiles	**Log K_{ow}**				
1,4-Dichlorobenzene	2.0	No	3	142.7	142.7
4-Methylphenol	2.0	No	4	164.5	164.5
Metals	**Log BCF**				
Aluminum	2.5	No	3	59.2	59.2
Barium	2.1	No	4	1.8	1.8
Lead	2.2	Yes	2	0.4	0.4

List of compounds significantly higher in clams exposed to dredged material from IHNC DMMUs than in clams exposed to sediment from the San Bernard reference site, their associated partitioning coefficient (Log K_{ow} or Log BCF), potential concern as bioaccumulative compounds, and highest measured mean factor of exceedance, body residue and estimated steady-state body residue.

significance. Lead is therefore ruled out as likely posing any potential detrimental ecological or human health effect to the disposal area.

Those metals and semivolatile compounds are ruled out as likely posing any potential detrimental ecological or human health effect to the disposal area. The bioaccumulation of 4,4'-DDT, delta-BHC, dieldrin, endosulfan II, heptachlor epoxide, dibenzofuran, fluoranthene, fluorine, phenanthrene, and pyrene is not ruled out as potentially posing detrimental ecological effect to the Mississippi River disposal and is therefore further evaluated.

Bioaccumulation of PAHs

The potential ecological effects of the bioaccumulation of the PAHs dibenzofuran, fluoranthene, fluorine, phenanthrene, and pyrene were evaluated by direct comparison of total PAH tissue residues (sum concentration of acenaphthene, acenaphthylene, anthracene, benzo(a)-anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(ghi)perylene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, dibenzofuran, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, and pyrene) from clams exposed to sediment from each IHMC dredged material with the critical body residue (CBR) for nonpolar organic chemicals as described in the freshwater bioaccumulation evaluation section.

The total PAH level in tissues from clams for DMMUs evaluated for bioaccumulation potential ranged from 2.0 µmol/kg lipid to 12.6 µmol/kg lipid (Table 58). Using a lipid content of 1% for the marine clams used in the estuarine evaluation, the highest value is approximately 24,000 times less than the levels at which chronic narcotic effects might be expected and 240,000 times less than the levels at which acute narcotic effect might be expected.

Table 58. *Macoma nasuta* 28-day estuarine solid phase bioaccumulation tests.

DMMU/Site	Total PAHs (µmol/kg lip)
3 F	2.5
4/5 N	2.0
7 N	12.6
9-2,4 NN	7.3
MIT	2.0
SB	1.6
Mean total PAH estimated steady-state body residue in clams exposed to dredged material from IHNC DMMUs, mitigation site sediment, and reference site.	

Further evaluation of the potential ecological effects of the bioaccumulation of PAHs was conducted by comparing the total PAH level in tissues from clams exposed to sediment in the DMMUs to Narcosis Final Chronic Values (FCV) developed using the target lipid model, as described in the freshwater bioaccumulation evaluation section. The body residue in the tissues of the clams exposed to sediment from a DMMU evaluated for

bioaccumulation was compared to the Narcosis FCV for PAHs (3,790 µmol/kg lipids). The highest mean sum PAH body residue (12.6 µmol/kg lipids) represents only 0.3% of the Narcosis FCV derived using the target lipid model.

Based on this evaluation, PAHs are ruled out as posing likely adverse ecological effect to the mitigation site disposal area.

Bioaccumulation of 4,4'-DDT, delta-BHC, dieldrin, endosulfan II, and heptachlor epoxide

The bioaccumulation of compounds with significant exceedance and a difference from the reference higher than a factor of two was evaluated for their potential to cause toxic effects in the benthos and their potential to bioaccumulate and cause toxic effects in predator pelagic freshwater fish. Information on the relationship between body residues and effects was obtained from the Environmental Residue Effects Database (ERED) (http:www.wes.army.mil/el/ered).

4,4'-DDT

The highest body residues for 4,4'-DDT were 8.0 µg/kg lipids or 0.080 µg/kg wet weight using 1% lipid content and adjusting for steady state. This concentration is over three orders of magnitude lower than no-observed-effect residue (320 µg/kg) for a sensitive freshwater invertebrate, *Hyalella azteca*. The reported lethal body burden for that species is 640 µg/kg. The lowest reported lethal body burden for marine or estuarine invertebrates was 1,000 µg/kg, for the blue crab, *Callinectes sapidus*. Therefore, the bioaccumulation of DDT is not expected to result in adverse toxic effects to estuarine benthic invertebrates at the disposal site.

DDT has high potential to transfer from prey invertebrates to predator fish through the dietary pathway. The lowest-no-effect residue (whole body) for freshwater fish was 180 µg/kg, reported for rainbow trout. This is the highest concentration of DDT in freshwater clams evaluated for bioaccumulation by three orders of magnitude. The lowest reported lethal body burden for marine or estuarine fish was 550 µg/kg, for pinfish, *Lagodon rhomboides*. Therefore, even if the concentration of DDT in fish is biomagnified by a factor of 10, body residues are substantially lower than any reported critical body residues and are not expected to result in

adverse toxic effects to fish preying on estuarine benthic invertebrates at the disposal site.

Dieldrin

The body residues for dieldrin were 5.4 µg/kg lipids or 0.054 µg/kg wet weight using 1% lipid content and adjusting for steady state for DMMU 9-2,4 NN. This concentration is three orders of magnitude lower than lowest-observed-effect residue (80 µg/kg) for marine invertebrate, the pink shrimp, *Penaeus duorarum*, the lowest LOEC reported for this compound for aquatic invertebrates. The bioaccumulation of dieldrin is not expected to result in adverse toxic effects to estuarine benthic invertebrates at the disposal site.

Dieldrin has high potential to transfer from prey invertebrates to predator fish through the dietary pathway. The lowest-observed-effect residue (whole body) for fish was 110 µg/kg, reported for rainbow trout, *Oncorhynchus mykiss*, growth. This concentration, the lowest LOEC reported for fish for this compound, is three orders of magnitude the highest concentration of alpha-chlordane in estuarine clams evaluated for bioaccumulation. The lowest reported critical body burden (decrease in reproduction) for marine or estuarine fish was 260 µg/kg, for largemouth basss, *Micropterus salmoides*. Even if the concentration of dieldrin in fish is biomagnified by a factor of 10, body residues are substantially lower than any reported critical body residues and are not expected to result in adverse toxic effects to fish preying on estuarine benthic invertebrates at the disposal site.

Endosulfan II

The body residues for endosulfan II were 25.6 µg/kg lipids or 0.026 µg/kg wet weight using 1% lipid content and adjusting for steady state for DMMU 9-2,4 NN. This concentration is four orders of magnitude lower than lowest-observed-effect residue (480 µg/kg) for marine invertebrate, the grass shrimp, *Palaemonetes pugio*, the lowest critical body residue reported for this compound for aquatic invertebrates. The bioaccumulation of dieldrin is not expected to result in adverse toxic effects to estuarine benthic invertebrates at the disposal site.

Endosulfan II has high potential to transfer from prey invertebrates to predator fish through the dietary pathway. The lowest-observed-effect

residue (whole body) for fish was 68 µg/kg, reported for spot, *Leiostomus xanthurus*, survival. This concentration, the lowest LOEC reported for fish for this compound, is the highest concentration of endosulfan II in estuarine clams evaluated for bioaccumulation by three orders of magnitude. Even if the concentration of alpha-chlordane in fish is biomagnified by a factor of 10, body residues are substantially lower than any reported critical body residues and are not expected to result in adverse toxic effects to fish preying on estuarine benthic invertebrates at the disposal site.

Heptochlor epoxide

The highest body residues for heptochlor epoxide was 10.0 µg/kg lipids or 0.1 µg/kg wet weight using 1% lipid content and adjusting for steady state. This concentration is over three orders of magnitude lower than lowest-observed-effect residue (180 µg/kg) for marine invertebrate, the pink shrimp, *Penaeus duorarum*, the lowest critical body residue reported for this compound for aquatic invertebrates. The bioaccumulation of heptochlor epoxide is not expected to result in adverse toxic effects to estuarine benthic invertebrates at the disposal site.

Heptochlor epoxide has high potential to transfer from prey invertebrates to predator fish through the dietary pathway. The lowest-observed-effect residue (whole body) for fish was 720 µg/kg, reported for spot, *Leiostomus xanthurus*, survival. This concentration, the lowest LOEC reported for fish for this compound, is the highest concentration of heptochlor epoxide in estuarine clams evaluated for bioaccumulation by four orders of magnitude. Even if the concentration of heptochlor epoxide in fish is biomagnified by a factor of 10, body residues are substantially lower than any reported critical body residues and are not expected to result in adverse toxic effects to fish preying on estuarine benthic invertebrates at the disposal site.

Conclusions

The disposal of dredged material from DMMUs 9-2,4 NN, 3 F, 4/5 N, and 7 N to the mitigation site disposal area is not likely to have an unacceptable adverse effect on survival, growth, or reproduction of benthic invertebrates or fish due to bioaccumulation.

Tissue concentrations of all contaminants for DMMUs not predicted to be toxic to benthic organisms and further evaluated for open water placement

at the mitigation site (DMMUs 4/5 N, DMMU 7 N, DMMU 9-2,4 NN) were either statistically less than USFDA action levels or there are no USFDA levels for the contaminants. For those DMMUs, tissue concentrations of contaminants of concern in organisms exposed to dredged material statistically exceeded those of organisms exposed to the reference material, except for DMMU 4/5 N. However, the technical evaluation of the bioaccumulation data determined that DMMUs not predicted to be toxic to benthic organisms are not likely to have an unacceptable adverse effect on survival, growth, or reproduction of aquatic organisms due to bioaccumulation.

7 Summary

Dredged material disposal plan

Two construction alternatives are being considered for the IHNC Lock replacement project: 1) a float-in-place alternative that would involve construction of lock modules at an off-site graving area and transportation (floating in) of each module for assembly at the IHNC construction site, and 2) a cast-in-place alternative that would involve on-site construction. These alternatives differ with respect to dredging volumes and construction sequence, with the cast-in-place alternative requiring greater dredging dimensions (and dredged material volumes) to accommodate on-site construction. Table 59 summarizes dredging volumes by DMMU for each alternative. Table 59 is identical to Table 36 and is included again for convenience.

A preliminary dredged material disposal plan was presented in the report *Conceptual CDF Design for Inner Harbor Navigation Canal Lock Replacement Project* (USAE-ERDC 2008). The disposal plan was based on results from aquatic and benthic toxicity tests performed on the DMMUs and proposed disposal of dredged material primarily in the Mississippi River with some disposal in a CDF. The beneficial use of dredged material both as a source of backfill around the lock construction site and for wetland creation at the mitigation site was discussed. However, the focus of the report was on a conceptual design for the proposed CDF and therefore presented a more detailed discussion of the maximum capacity that might be required for the project, including separate cells within the CDF for temporary stockpiling of material and for material unsuitable for disposal in the Mississippi River, while limiting discussion on placement of material at the mitigation site. Dredged material volumes from the disposal plan described in that report are presented in Table 59 under the column “Volume to Selected Placements Alternative II.”

This sediment evaluation proposes a revised dredged material disposal plan that includes an open-water disposal area in the Mississippi River, a wetland creation disposal site within the mitigation area, a CDF disposal site for material unsuitable for open-water placement (restricted material), and a separate fill storage site within the CDF. Dredged material volumes from this alternative appear in Table 59 under the column “Volume to

Selected Placements Proposed Alternative." Results from aquatic and benthic toxicity tests and water column mixing zone analyses were evaluated to determine the suitability of DMMUs for discharge into the four disposal areas. That proposed alternative is summarized below.

- DMMUs 3 NN, 3 N, 4 NN, 7 F, 7 N (area underlying channel sediments), 8 NN, 9 NN (area south of the existing lock), 10 NN, 10 F, and 10 N would be placed in the Mississippi River.
- DMMUs 3 F, 4/5 N, 7 N (area underlying east bank fill), and 9 NN (area north of the existing lock) would be placed at the mitigation site for wetland creation. Note that the USAE-ERDC (2008) disposal plan proposed placement of these DMMUs into the Mississippi River.
- DMMUs 1 NN, 2 NN, 5 NN, and 7 NN would be placed in the CDF.
- DMMUs 6 NN, 6 F, and 6 N would be temporarily stockpiled in the CDF and later used as backfill at the construction site. Note that for the cast-in-place construction alternative, portions of DMMU 6 NN, 6 F, and/or 6 N would be placed in the Mississippi River.

Compliance of proposed discharges with water quality standards

Mississippi River disposal area

Effluent concentrations were used to evaluate potential for exceedances of water quality criteria during open-water disposal in the Mississippi River (MR) disposal site. Louisiana State regulations provide specifications for mixing zones to assimilate effluent discharges. Dilution requirements were therefore calculated based on comparison of maximum effluent concentrations to water quality criteria. Table 60 summarizes all non-zero dilution ratios calculated for disposal at the Mississippi River disposal site based on standard elutriates. A maximum dilution of 69, for barium, was required to meet freshwater acute criteria, and a maximum dilution of 697, for Total PCBs, was required to meet freshwater chronic criteria.

Dilutions based on mean (geometric mean) elutriate concentrations resulted in a maximum dilution requirement of 18 to meet freshwater acute criteria and a dilution requirement of 90 to meet freshwater chronic criteria (both for barium) (see section titled "Potential water quality impacts associated with open water disposal of dredged material" on page 47).

Maximum dilutions obtained based on toxicity testing of freshwater elutriates ranged from 1 to 384.

Based on the modeling conducted for disposal in the Mississippi River disposal site, a 700-fold dilution could be met within 2,100 ft from the discharge point for low flow conditions and within 1,000 ft for high flow conditions. This will meet the most stringent dilution requirements based on comparison of elutriate concentrations to water quality criteria and will also satisfy the maximum dilution requirements based on the elutriate toxicity testing. This distance is consistent with the point at which non-detect concentrations have been observed during disposal operations in the past. Also, the dilutions required to be protective based on aquatic toxicity tests can be met within approximately 1,400 ft for worst case conditions (low flow, pipeline disposal), as the maximum dilution based on toxicity was less than 400. As these mixing zone dimensions appear to be reasonable and consistent with past operation, it appears that the proposed discharges of dredged material would comply with state water quality standards or with equivalent benchmarks. Further, evaluation of potential impacts on the St. Bernard Parish waterworks inlet indicates that dilution required to meet drinking water standards can be achieved within no more than 350 ft from the point of disposal for all scenarios.

Mitigation site

Due to present uncertainty regarding method of containment, estimated water column impacts associated with placement of dredged material at the mitigation site were evaluated based on both standard and modified elutriate tests. For the DMMUs selected for placement in the mitigation site, maximum dilution required to meet chronic water quality criteria was 170, for tributyltin (standard elutriate), and to meet acute criteria was 14, for cyanide (modified elutriate). Non-zero dilutions obtained for placement in the mitigation site based on standard and modified elutriates and location of maximums are summarized in Tables 61 and 62, respectively. Little flow information was available for the mitigation site. Available dilution in the mitigation site was estimated based on the best information available. Assuming an average maximum water depth of 2 ft, a 6-in. tidal variation would therefore represent a daily exchange of approximately 25 percent of the maximum water volume or an effective flow rate of 111 cfs. This would yield an approximate dilution ratio of 4:1 for the effective discharge rate of a 24-in. hydraulic dredge. This is insufficient to meet maximum dilution requirements for acute or chronic criteria, in addition to requiring an area larger than that specified for either a zone of initial dilution or a mixing zone under LA water quality regulations. However, suspended phase toxicity testing conducted on the marine

elutriates did not result in significant toxicity even at full strength. If no other adverse effects are anticipated with the placement, and given the interest and benefit associated with restoration of the wetland, this may be sufficient justification for a waiver from water quality criteria for this action.

CDF effluent

Effluent discharges from the CDF were evaluated based on modified elutriate tests. For discharge to the GIWW, a maximum dilution of 770, for copper, was required to meet marine acute criteria, and a maximum dilution of 3179, for tributyltin, was required to meet marine chronic criteria (Table 63). Due to apparent analytical problems, some of the highest values (associated with DMMU 10 sample C3_4-N) are considered unreliable, however. Maximum dilution based on the highest reliable sample concentration for copper (DMMU 4 sample 5-NN) resulted in a dilution ratio of 8 to meet acute (and chronic) criteria. A similar issue was noted for lead for which the highest reliable elutriate concentration (DMMU 4/5 sample 8-N) results in a dilution ratio of 8 to meet marine chronic criteria (and 0 to meet acute criteria). Maximum overall dilution remains at 3179 for marine chronic, due to the high concentration of tributyltin in the modified elutriate of DMMU 4 sample 4-NN. For that sample, the dilution ratio estimate is considered reliable.

Survival was not statistically different from control in toxicity testing conducted on estuarine standard elutriate (considered reasonably representative of toxicity expected with modified elutriates, based on comparison of elutriate concentrations), and no LC50 values resulted. Therefore, no dilution of effluent is considered necessary for discharge in the marine environment based on toxicity.

The maximum attainable dilution ratio in compliance with mixing zone restrictions in the GIWW is estimated to be approximately 120. Assuming maximum copper and lead dilution requirements are revised as previously discussed, adequate dilution will be attainable within the mixing zone for all constituents except tributyltin (dilution ratio 3179 chronic), total PCBs (dilution ratio 404 chronic), Aroclor 1016 (dilution ratio 321 chronic), and dieldrin (dilution ratio 128 chronic). Effluent treatment may be required to address elevated levels of these constituents when dredging certain areas of the IHNC. However, the mixing that is inherent in dredging will likely flatten peak concentrations somewhat. Based on the geometric mean elutriate concentrations (Section titled “Potential water quality impacts

Table 59. Dredging and disposal plan (revised 7/17/08).

In-Situ Volumes by Location and Material Type (yd³)								Volume to Selected Placements Alternative II (ERDC 2008) (yd³)								Volume to Selected Placements Proposed Alternative (yd³)								Approximate Year Dredged			
		Suitability (No Benthic Toxicity)		Total Volume		Volume by Section		Float in Place				Cast in Place				Float in Place				Cast in Place							
										CDF				CDF				CDF				CDF							
DMMU/ Location	Material Type[1]	FW[2]	SW[3]	FIP	CIP	FIP	CIP	Open Water	Wetland	Disposal	Fill Storage	Open Water	Wetland	Disposal	Fill Storage	Open Water	Wetland	Disposal	Fill Storage	Open Water	Wetland	Disposal	Fill Storage	Float-in-Place	Required Fill Volumes (yd³)	Cast-in-Place	Required Fill Volumes (yd³)
D1-05-1 thru 6	NN	USm4	USm	48,100	48,100	48100	48100	0	0	48100	0	0	0	48100	0	0	0	48100	0	0	0	48100	0	7	106762n	6	354203n
D2-05-1 thru 6	NN	USm	USm	88,700	155,200	88700	155200	0	0	88700	0	0	0	155200	0	0	0	88700	0	0	0	155200	0	7		6	
D3-05-1 thru 3	F	S5	S	412,750	586,300	62850	196700	412750q	0	0	0	586300q	0	0	0	0	062850a	0	0	389600	196700	0	0	2-3	None	2-3	None
D3-05-4 thru 6	NN	S	US			349900	389600		0	0	0		0	0	0	349900a	0	0	0		0	0	0	2-3		2-3	
D3-05-1N thru 6N	N	S	US			a	a		0	0	0		0	0	0		0	0	0		0	0	0	2-3		2-3	
D4-05-1 thru 8	NN	S	US	152,800	257,800	152,800	257,800	152800	0	0	0	257800	0	0	0	152800	0	0	0	257800	0	0	0	2-3		2-3	
D5-05-1 thru 8	NN	US	US	143,400	245,200	78,500	83,500	0	0	78500	0	0	0	83500	0	0	0	78500	0	0	0	83500	0	2-3		2-3	
D4/5-05-1N-16N	N	S	S	b	b	64900h	161700h	64900q	0	0	0	161700q	0	0	0	0	64900	0	0	0	161700	0	0	2-3		2-3	
D6-05-1 & 2	NN	S	S	463,100	997,700	463,100	997,700	0	0	0	463100	346678	0	0	651022	59100	0	0	404000	346678	0	0	651022	1	None	1	None
D6-05-3 thru 6	F	S	S																					1		1	
D6-05-1N thru 6N	N	S	S																					1		1	
D7-05-1 thru 4	NN	US	S	413,000	620,900	101500	152500	0	0	101500	0	0	0	152500	0	0	0	101500	0	0	0	152500	0	1		1	
D7-05-5 thru 9	F	S	S			228000	79400	311500q	0	0	0	468400q	0	0	0	228000	0	0	0	79400	0	0	0	1		1	
D7-05-1N-4N	N	S	S			c	c																	1		1	
D7-05-5N-9N	N					83500	389000									0	83500				389000						
D8-05-1 thru 4	NN	S	US	132,000	162,000	132,000	162,000	132000	0	0	0	162000	0	0	0	132000	0	0	0	162000	0	0	0	7		7	

In-Situ Volumes by Location and Material Type (yd³)								Volume to Selected Placements Alternative II (ERDC 2008) (yd³)								Volume to Selected Placements Proposed Alternative (yd³)								Approximate Year Dredged			
		Suitability (No Benthic Toxicity)		Total Volume		Volume by Section		Float in Place				Cast in Place				Float in Place				Cast in Place							
										CDF				CDF				CDF				CDF						
DMMU/ Location	Material Type[1]	FW[2]	SW[3]	FIP	CIP	FIP	CIP	Open Water	Wetland	Disposal	Fill Storage	Open Water	Wetland	Disposal	Fill Storage	Open Water	Wetland	Disposal	Fill Storage	Open Water	Wetland	Disposal	Fill Storage	Float-in-Place	Required Fill Volumes (yd³)	Cast-in-Place	Required Fill Volumes (yd³)
D9-05-1&3	NN	S	US	192,200	192,200	192,200	192,200	150000	0	0	0	150000	0	0	0	150000	0	0	0	150000	0	0	0	11	None	11	None
D9-05-2&4	NN	S	S					42200q	0	0	0	42200q	0	0	0	0	42200	0	0	0	42200	0	0	7		7	
D10-05-1	F	S	S	131,400	131,300	18300	18300	131,400	0	0	0	131,300				131,400	0	0	0	131,300				7	246825j	7	246825j
D10-05-2	F	d	d			e	e																	7		7	
D10-05-3&4	S	S	S			113100	113000																	7		7	
D10-05-1N	N	d	d			f	f																	7		7	
D10-05-2N	N	d	d			e	e																	7		7	
D10-05-3N&4N	N	S	S			g	g																	7		7	
D11-05-1&2	NN	d	d	38,782	38,782	38782i	38782i	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11		11	
Totals				2,216,232	3,435,482	2,216,232	3,435,482	1397550q	0	316800	463100	2306378q	0	439300	651022	1203200	253450	316800	404000	1516778	789600	439300	651022	Total	353587	Total	601028
								Grand Total 2,177,450				Grand Total 3,396,700				Grand Total 2,177,450				Grand Total 3,396,700				Capping Allowance	50000	Capping Allowance	50000
																								Grand Total	403587	Grand Total	651028

[1] Native/Non-native/Fill/Sediment, [2] Freshwater, [3] Saltwater, [4] Unsuitable, [5] Suitable, a Native volumes included with 1-3 and 4-6 volumes above, therefore wetland placement volume is overestimated by the volume underlying DMMU 1 Sites 1-3, and the open water volume is underestimated by the same amount, b 4/5 is a vertical designation, volume included with 4 and 5, c Native below project depth (at -36ft), d Unknown assumed S, e Site 2 not sampled, f Included with 1 above, g Included with 3&4 above, h DMMU 5 native volumes only, DMMU 4 volumes were estimated as NN to full project depth, i Not scheduled for dredging, j Letter report assumes 70K of material being dredged plus remainder from previously stockpiled goes to fill. However water management at the lock fill site would be a problem if dredging hydraulically due to the small size of the site and limited hydraulic retention time, m Not tested, assumed unsuitable, n Letter report specifies backfill of West Side of New lock after U/S and D/S approach - assumed here to correspond to main north channel, q shaded areas represent material proposed for open water disposal in Alternative II (USAE-ERDC 2008), portions of which are proposed for wetland placement in proposed alternative

Table 60. Summary of non-zero dilution requirements for disposal in MR disposal site.

Contaminants	Maximum Elutriate Concentration (µg/L)	Dilution Ratios		Location of Maximum Concentration
		Meeting Acute Criteria	Meeting Chronic Criteria	
PCB Total	2.80	0.4	697	DMMU 5 sample 4-NN
p,p'-DDT (4,4')	0.062	0	432	DMMU 4 sample 5-NN
Barium	2590	69	339	DMMU 10 sample C3_4-FN
Cadmium	15.6	9	301	DMMU 10 sample C3_4-FN
Tributyltin	13.0	29	256	DMMU 4 sample 4-NN
Benzo(a)anthracene	1.00	1	94	DMMU 4 sample 5-NN
Aluminum	4690	5	61	DMMU 10 sample C3_4-FN
PCB(Aroclor-1254)	0.930	0.6	39	DMMU 4 sample 5-NN
gamma-Chlordane	0.074	0	39	DMMU 7 sample 2-NN
Heptachlor	0.100	0	38	DMMU 4 sample 5-NN
PCB(Aroclor-1016)	0.160	0	37	DMMU 4 sample 5-NN
4,4'-DDD	0.160	4	30	DMMU 7 sample 2-NN
Benzo(a)pyrene	0.370	0.90	28	DMMU 4 sample 5-NN
Heptachlor epoxide	0.054	0	20	DMMU 5 sample 4-NN
PCB(Aroclor-1248)	1.50	0.1	20	DMMU 5 sample 4-NN
Cyanide	14.2	0	17	DMMU 4 sample 5-NN
Beryllium	3.00	0	15	DMMU 10 sample C3_4-FN
Silver	1.25	0	14	DMMU 10 sample C3_4-FN
Selenium	61.2	2	14	DMMU 10 sample C3_4-FN
Lead	9.90	0	10	DMMU 10 sample C3_4-FN
Chromium III	693	1.25	8.78	DMMU 10 sample C3_4-FN
Ammonia-N	16900	0	8	DMMU 4 sample C1_3-NN
Mercury	0.170	0	6	DMMU 10 sample C3_4-FN
alpha-Chlordane	0.015	0	4	DMMU 5 sample 4-NN
Methoxychlor	0.072	NS	2	DMMU 4 sample 5-NN
Copper	14.1	0.52	1.45	DMMU 10 sample C3_4-FN
Bis(2-ethylhexyl) phthalate	5.70	0	1.0	DMMU 7 sample 4-NN
Anthracene	1.30	0	0.9	DMMU 4 sample 5-NN
Dieldrin	0.098	0	0.8	DMMU 7 sample 2-NN
Endrin	0.058	0	0.6	DMMU 4 sample 5-NN
Chromium VI	13.0	0	0.33	DMMU 10 sample C3_4-FN
Phenanthrene	6.90	0	0.1	DMMU 4 sample 5-NN

associated with release of effluent and runoff from confined disposal facilities" on page 71), all dilution requirements can be met within the prescribed mixing zone in the GIWW.

Table 61. Non-zero dilution ratios for placement in mitigation site based on standard elutriate testing.

	DMMU3[a]		DMMU4/5[b]		DMMU7N[e]		DMMU9[i]	
Contaminants	Acute	Chronic	Acute	Chronic	Acute	Chronic	Acute	Chronic
Tributyltin	0	n	0	170	0	n	0	n
PCB Total	0	13	0	22	0	0	0	4
Cyanide	n	n	11	11	11	11	6	6
Silver	0.32	10m	0.32	10m	0.32	10m	0.32	10m
Mercury	0	n	0	6	0	n	0	n
p,p'-DDT (4,4')	0	n	0	5	0	n	0	0
Copper	0	0	2	2	0	0	n	n
Lead	0	0	0	2	0	0	0	2
Endrin	0	0	0	0.33	0	0	0	0
Dieldrin	0	7	0	0	0	0	0	7
gamma-Chlordane	0	4	0	0	0	0	0	0

[a] DMMU 3 C1-3 Land, [b] DMMU 4/5N Comp 1&11, Sites 4, 5, 7, 8, 12 &13 [e] DMMU 7N Comp 1-9, [i] DMMU 9 Comp 2&4, m Based on EPA Region IV Water Quality Screening Criteria for Hazardous Waste Sites, n Background Exceeds WQC and Elutriate Concentrations

Table 62. Non-zero dilution ratios for placement in mitigation site based on modified elutriate testing.

	DMMU3[a]		DMMU4/5[b]		DMMU7N[e]		DMMU9[i]	
Contaminants	Acute	Chronic	Acute	Chronic	Acute	Chronic	Acute	Chronic
Lead	0	0	0	26	0	n	0	0
p,p'-DDT (4,4')	0	4	0	n	0	1.31	0	n
Cyanide	11	11	14	14	n	n	3	3
Silver	0.32	10m	0.32	10m	0.32	10m	0.32	10m
Dieldrin	0	13	0	0	0	0	0	0
Endrin	0	1	0	0	0	0	0	0
gamma-Chlordane	0	0.83	0	0	0	0	0	0

[a] DMMU 3 C1-3 Land, [b] DMMU 4/5N Comp 1&11, Sites 4, 5, 7, 8, 12 &13 [e] DMMU 7N Comp 1-9, [i] DMMU 9 Comp 2&4, m Based on EPA Region IV Water Quality Screening Criteria for Hazardous Waste Sites, n Background Exceeds WQC and Elutriate Concentrations

Table 63. Maximum non-zero dilution ratio estimates for effluent discharge in the GIWW and Bayou Bienvenue based on modified elutriate.

Contaminants	Maximum Elutriate Concentration (µg/L)	GIWW (DMMU1) Dilution Ratios		Bayou Bienvenue Dilution Ratios		Location of Maximum
		Meeting Acute Criteria	Meeting Chronic Criteria	Meeting Acute Criteria	Meeting Chronic Criteria	
Tributyltin	6.7	16	3179	16	3105	DMMU 4 sample 4-NN
Copper	281	770	770	226	397	DMMU 10 sample C3_4-NF
PCB Total	2.2	0.10	404	0.10	547	DMMU 7 sample 2-NN
PCB(Aroclor-1016)	0.84	0g	321g	0g	41g	DMMU 7 sample 7-F
Lead	147	4	197	4	180	DMMU 10 sample C3_4-NF
Dieldrin	0.082	0	128	0	59	DMMU 7 sample 2-NN
PCB(Aroclor-1260)	1.6	0.53g	121g	0.53g	79g	DMMU 7 sample 2-NN
PCB(Aroclor-1254)	0.45	0g	114g	0g	21g	DMMU 7 sample 5-F
p,p'-DDT (4,4')	0.0059	0	43	0	34	DMMU 5 sample 4-NF
Cadmium	2.1	0	d	0	12	DMMU 10 sample C3_4-NF
Endosulfan II	0.039	0.20	31	0.33	10	DMMU 7 sample 2-NN
p,p'-DDD (4,4')	0.14	4	25	4	29	DMMU 7 sample 2-NN
gamma-Chlordane	0.066	0	19	0	81	DMMU 7 sample 2-NN
Nickel	133	0.81	17	0.84	27	DMMU 10 sample C3_4-NF
Mercury	0.28	0	17	0	17	DMMU 10 sample C3_4-NF
Zinc	522	9	11	8	9	DMMU 10 sample C3_4-NF
Ammonia-N	19600	0.78	11	0.78	11	DMMU 1 sample C1_6-NN
PCB(Aroclor-1248)	0.24	0g	8g	0g	11g	DMMU 9 sample C1_4-NN
Heptachlor	0.025	0	7	0	d,g	DMMU 6 sample 2-N
Chromium VI	42.0	2	3	2	3	DMMU 1 sample 1-NN
Cyanide	6.6	2	2	2	2	DMMU 6 sample 6-F
gamma-BHC (Lindane)	0.029	0	2.17g	0	1g	DMMU 1 sample 1-NN
Chromium III	216	0	1	0	1	DMMU 10 sample C3_4-NF
Methoxychlor	0.052	NS	0.77	NS	0.80	DMMU 1 sample C1_6-NN
Endrin	0.0027	0	0.44	0	0.40	DMMU 3 sample C1_3-F
alpha-Chlordane	0.0047	0	0.21	0	0.58	DMMU 3 sample C1_3-F
Arsenic	37.8	0	0.06	0	0.06	DMMU 10 sample C3_4-NF
Selenium	61.4	0	0	0	0	DMMU 1 sample C1_6-NN

NS - no standard

a As III, d assumed background concentration exceeds criteria, elutriate concentration near background concentration, dilution ratio cannot be calculated, g based on EPA Region IV screening water quality criteria for hazardous waste sites

Activated carbon may be effective in reducing organic concentrations in the effluent prior to discharge, thus reducing dilution requirements substantially. Bench testing will be required to evaluate effectiveness for

different methods of application and to determine needed carbon dosage and contact time.

For discharge to Bayou Bienvenue, a maximum dilution of 226, for copper, was required to meet marine acute criteria (DMMU 10 sample C3&4-N), and a maximum dilution of 3105, for tributyltin, was required to meet marine chronic criteria (DMMU 4 sample 4-NN) (Table 63).

However, DMMU 10 sample C3&4-N results are considered unreliable, as previously discussed. Maximum dilution based on the highest reliable sample concentration (DMMU 4 sample 5-NN) resulted in a dilution ratio of 2.6 to meet acute criteria for copper (5.3 for chronic criteria). Lead dilution requirements were also relatively high to meet chronic criteria (180), but again the maximum elutriate concentration was associated with DMMU 10 sample C3&4-N. Substitution of the highest reliable elutriate concentration for lead (DMMU 4/5 sample 8-N) results in a dilution ratio of 7 to meet marine chronic criteria (0 to meet acute). Maximum overall dilution remains at 3105 for marine chronic, due to the high concentration of tributyltin in DMMU 4 sample 4-NN. Dilutions based on mean (geometric mean) elutriate concentrations (Section titled “Potential water quality impacts associated with release of effluent and runoff from confined disposal facilities” on page 71) indicated all marine acute criteria were met without mixing, and a maximum dilution of 8 was required to meet marine chronic criteria.

Data regarding geometry and flow rate in Bayou Bienvenue was insufficient to permit modeling of a mixing zone as was done for the GIWW. Bayou Bienvenue is sufficiently small in depth and width and the flow rate is sufficiently low that discharge from the CDF would fully envelop and mix with the entire flow of Bayou Bienvenue within approximately 200 ft of the discharge. As such, the dilution achieved is simply a ratio of the flow of Bayou Bienvenue and the CDF discharge. Flow rate within Bayou Bienvenue was estimated based on available information and appears to be quite limited, consisting of tidal exchange, surface runoff, and stormwater pumping.

An attainable dilution ratio of 3:1 was estimated for effluent discharge in Bayou Bienvenue, which is inadequate to meet water quality criteria for the effluent pathway without treatment. For discharge of runoff, however, which could be released more gradually during periods of higher flow in

Bayou Bienvenue, the dilution available was estimated to range from 44:1 to 380:1 or greater. This is adequate to meet dilution requirements for runoff without treatment (based on acute criteria) for both maximum and mean predicted concentrations. Dilution requirements for runoff from dried, oxidized material have not yet been determined but are expected to be somewhat higher due to increased solubilization of metals under oxidized conditions.

Potential for contaminant-related impacts that would result in significant degradation of the aquatic ecosystem

Based on results from previous evaluations (Appendix A), poor survival of benthic organisms, and proximity of sediment collection sites to suspected areas of contamination, dredged material from DMMUs 1 NN and 2 NN was determined to be unsuitable for freshwater and estuarine open water placement.

Mississippi River open water disposal evaluation

Based on the results of the benthic toxicity evaluation (Table 64), IHNC non-native sediments from DMMU 5 and from DMMU 7 (DMMUs 5 NN and 7 NN) are predicted to be acutely toxic to freshwater benthic organisms as the survival of freshwater amphipods exposed to dredged material from those DMMUs was significantly lower than for the reference site in solid phase toxicity tests. Therefore, dredged material from DMMUs 5 NN and 7 NN is unsuitable for disposal in the Mississippi River. Dredged material from the remaining DMMUs is not predicted to be acutely toxic to freshwater benthic organisms and was further evaluated for bioaccumulation potential using solid-phase exposures of a freshwater clam to dredged material.

The benthic bioaccumulation evaluation revealed that tissue concentrations of all contaminants of concern for DMMUs evaluated were either statistically less than USFDA action levels or there are no USFDA levels for the contaminants. For contaminants with USFDA action levels, body burden in clams exposed to dredged material was lower than reported action levels by over two orders of magnitude (Table 64). Moreover, tissue concentration associated with the DMMUs evaluated for bioaccumulation were statistically less than Fish Contaminant Goals (FCGs) developed by The California Office of Environmental Health Hazard Assessment (OEHHA) or there are no FCG for the contaminants.

Further evaluation revealed that statistically elevated tissue residue relative to the reference site was detected for at least one COC for all DMMUs investigated for bioaccumulation potential. The sample with the highest number of exceedences was fill material from DMMU 3 F, with 15 COC exceeding the Mississippi River reference. Compounds statistically elevated in tissue residue which are considered of low concern as bioaccumulative compounds were aluminum, barium, chromium, 4-methylphenol, diethyl phthalate, and phenol. Compounds with high potential concern as bioaccumulative compounds were lead, nickel, selenium, tributyltin, PAHs, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, alpha-chlordane, and PCBs. Despite their statistically elevated concentration, compounds with both low and high bioaccumulative potential are not likely to promote unacceptable adverse biological effects based on 1) the low magnitude of exceedence, 2) the small number of contaminants with potential to bioaccumulate in predator fish, and 3) prediction of no adverse biological effects associated with measured body residue in invertebrates and predicted body residue in predator fish. DMMUs proposed for discharge at the Mississippi River would therefore not result in adverse impacts to the aquatic ecosystem.

Mitigation site open water disposal evaluation

Based on the results of the solid phase toxicity tests (Table 65), IHNC dredged material from DMMUs 3NN,3 N, 4 NN, 5 NN, 8 NN, and 9 NN (portion south of the existing lock) are predicted to be acutely toxic to estuarine benthic organisms and are therefore unsuitable for open water disposal in the mitigation site. DMMUs predicted to be acutely toxic to estuarine benthic invertebrates were excluded from the bioaccumulation evaluation. In addition, DMMUs 3 N, 6 NN, 6 N, 6 F, 7 NN, 7 F, 10 NN, 10 N, and 10 F were determined by the water column evaluation to require considerable dilution and were not further evaluated for disposal at the mitigation site.

Due to no apparent benthic or water column toxicity and minimal dilution requirements, DMMUs 3 F, 4/5 N, 7 N, and 9 NN (portion north of the existing lock) were evaluated for bioaccumulation potential at the mitigation site disposal area using solid phase exposures of a marine clam to dredged material.

The benthic bioaccumulation evaluation revealed that tissue concentrations of all contaminants of concern for DMMUs evaluated were either

statistically less than USFDA action levels or there are no USFDA levels for the contaminants. For contaminants with USFDA action levels, body burden in clams exposed to dredged material was lower than reported action levels by over three orders of magnitude (Table 65). Moreover, tissue concentration associated with the DMMUs evaluated for bioaccumulation was statistically less than FCGs developed by OEHHA or there are no FCG for the contaminants.

Table 64. Summary of benthic toxicity and bioaccumulation evaluations for freshwater open water disposal.

DMMU	Benthic Toxicity	Bioaccumulation Potential			
		Number of COCs Significantly Elevated	Highest Exceedance	Comparison of Body Rresidue to USFDA Action Levels	Potential for Aadverse Effects to Benthos and Fish
3 NN	Not toxic	6	27	> 10^2 lower	Negligible
3 N	Not toxic	1	3	> 10^2 lower	Negligible
3 F	Not toxic	15	71	> 10^2 lower	Negligible
4 NN	Not toxic	6	40	> 10^2 lower	Negligible
5 NN	Toxic	Bioaccumulation Potential Not Evaluated			
4/5 N	Not toxic	5	6	> 10^2 lower	Negligible
6 NN	Not toxic	7	5	> 10^2 lower	Negligible
6 N	Not toxic	2	3	> 10^2 lower	Negligible
6 F	Not toxic	1	2	> 10^2 lower	Negligible
7 NN	Toxic	Bioaccumulation Potential Not Evaluated			
7 N	Not toxic	4	7	> 10^2 lower	Negligible
7 F	Not toxic	1	2	> 10^2 lower	Negligible
8 NN	Not toxic	7	13	> 10^2 lower	Negligible
9-1 NN	Not toxic	2	7	> 10^2 lower	Negligible
9 2,4-NN	Not toxic	7	9	> 10^2 lower	Negligible
10_1NN	Not toxic	3	3	> 10^2 lower	Negligible
10 N	Not toxic	4	7	> 10^2 lower	Negligible
10 F	Not toxic	4	2	> 10^2 lower	Negligible

Further evaluation revealed that statistically elevated tissue residue relative to the reference site was detected for at least one COC for DMMUs 3 F, 7 N, and 9 NN (north of the existing lock), but not for DMMU 4/5 N. The sample with the highest number of exceedences was native subsurface material from DMMU 7 N with 10 exceedances. Compounds statistically elevated in tissue residue which are considered of low concern as bioaccumulative compounds were aluminum, barium, 1.4-dichloro-benzene, and 4-methylphenol. Compounds with high potential concern as

bioaccumulative compounds were lead, PAHs, 4,4'-DDT, delta-BHC, dieldrin, endosulfan II, and heptachlor epoxide. Despite their statistically elevated concentration, compounds with both low and high bioaccumulative potential are not likely to promote unacceptable adverse biological effects based on 1) the low magnitude of exceedance, 2) the small number of contaminants with potential to bioaccumulate in predator fish, and 3) prediction of no adverse biological effects associated with measured body residue in invertebrates and predicted body residue in predator fish. DMMUs proposed for discharge at the mitigation site would therefore not result in adverse impacts to the aquatic ecosystem.

Table 65. Summary of benthic toxicity and bioaccumulation evaluations for estuarine open water disposal.

DMMU	Benthic Toxicity	Bioaccumulation Potential			
		Number of COCs Significantly Elevated	Highest Exceedance	Comparison of Body Residue to USFDA Action Levels	Potential for Adverse Effects to Benthos and Fish
3 NN	Toxic	Bioaccumulation Potential Not Evaluated			
3 N	Toxic	Bioaccumulation Potential Not Evaluated			
3 F	Not toxic	3	3	> 10^3 lower	Negligible
4 NN	Toxic	Bioaccumulation Potential Not Evaluated			
5 NN	Toxic	Bioaccumulation Potential Not Evaluated			
4/5 N	Not toxic	0		> 10^3 lower	Negligible
6 NN	Not toxic	Bioaccumulation Potential Not Evaluated			
6 N	Not toxic	Bioaccumulation Potential Not Evaluated			
6 F	Not toxic	Bioaccumulation Potential Not Evaluated			
7 NN	Not toxic	Bioaccumulation Potential Not evaluated			
7 N	Not toxic	10	20		Negligible
7 F	Not toxic	Bioaccumulation Potential Not Evaluated			
8 NN	Toxic	Bioaccumulation Potential Not Evaluated			
9-1 NN	Toxic	Bioaccumulation Potential Not Evaluated			
9 2,4-NN	Not toxic	7	11	> 10^3 lower	Negligible
10_1NN	Not toxic	Bioaccumulation Potential Not Evaluated			
10 N	Not toxic	Bioaccumulation Potential Not Evaluated			
10 F	Not toxic	Bioaccumulation Potential Not Evaluated			

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(Appendix C of the FINAL IHNC Lock SEIS file)

Note: A DVD that includes all of the appendices associated with this report is available upon request. To obtain a copy of the DVD, please contact:

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Appendix A: TIER I Evaluation – Potential Sources of Contamination

To fulfill the requirements of the U.S. Environmental Protection Agency (USEPA) / U.S. Army Corps of Engineers (USACE) Implementation Memorandum for the Inland Testing Manual (ITM) dated February 12, 1998, the U.S. Army Engineer District, New Orleans (CEMVN) and USEPA Region VI developed a list of contaminants of concern (COC) that should be applied to all dredging projects that require testing according to the ITM. The list was finalized in March 2001 and includes the parameters that were determined to be the most likely contaminants of concern in sediments found in the area of the CEMVN. The COC list could be expanded based on a review of existing project-specific information. The primary source of the target detection limits (TDLs) for the parameters listed was EPA 823-B-95-001, *QA/QC Guidance for Sampling and Analysis of Sediments, Water and Tissues for Dredged Material Evaluations.*

To initiate efforts on development of the SAP and the project-specific COC list, CEMVN performed a literature search of existing, historical information, i.e. prior reports, studies and sampling programs. Project-specific biological testing (Tier III) was performed in the summer and fall of 2005 and provided additional information on sediments collected near the Florida Ave. Bridge. The sources researched for this Tier I Evaluation included the following:

A. *Analyses of Native Water, Bottom Material, Elutriate Samples, and Dredged Material From Selected Southern Louisiana Waterways and Selected Areas in the Gulf of Mexico*, 1979-81, prepared by the U.S. Department of the Interior, Geological Survey in cooperation with the U.S. Army Corps of Engineers.

B. *Mississippi River-Gulf Outlet, New Lock and Connecting Channels Evaluation Report*. March 1997. The following volumes of the Evaluation Report were used for the Tier I investigation.

a. *Volume 1. Main Report and Environmental Impact Statement.*
b. *Volume 3, Appendix B. Engineering Investigations.*
c. *Volume 5, Appendix C. Investigations of Potential Hazardous, Toxic, and Radiological Wastes.*
d. *Volume 6, Appendix D. Environmental Studies.*

C. *A Land Use History of Areas Adjacent to the Inner Harbor Navigation Canal Lock, New Orleans*. Final Report. November 1992. (Prepared by R. Christopher Goodwin & Associates, Inc.)

D. *IHNC Lock Replacement Project, Orleans Parish, LA; Design Documentation Report No. 1 Site Preparation and Demolition. Volume 6*. February 1999.

E. *RECAP Submittal Report – Criteria Document IHNC EBIA New Orleans, LA*. June 2001

F. National Pollutant Discharge Elimination System (NPDES)/Louisiana Pollutant Discharge Elimination System (LPDES) Permit Files.

G. *Port of New Orleans Florida Avenue Bridge Dredged Material Assessment Sampling Report*. February 2001.

H. Lake Pontchartrain Basin Foundation (LPBF) and Holy Cross Neighborhood Association sampling and analysis results (letter dated May 22, 2001 to CEMVN from Carlton Dufrechou, Lake Pontchartrain Basin Foundation, Metairie, LA).

A. *Analyses of Native Water, Bottom Material, Elutriate Samples, and Dredged Material From Selected Southern Louisiana Waterways and Selected Areas in the Gulf of Mexico*

During the period of July 1979 to September 1981, the U.S. Geological Survey (USGS), in cooperation with the CEMVN, conducted water quality studies dealing with dredging activities in selected reaches of major navigable waterways of southern Louisiana. One of the waterways studied was the Inner Harbor Navigation Canal (IHNC), where elutriate studies were conducted. The elutriate studies were initiated to collect data for use in assessing possible environmental effects of proposed dredging activities in selected reaches of Louisiana waterways including the IHNC. Native water and bottom-material samples were collected, analyzed, and used to prepare elutriates for analysis. Samples were collected from three sites in the IHNC. Plate 9 of the USGS report displays the locations of these sites. Several dissolved metals, phenols, and diazinon were detected in the elutriates.

B. *Mississippi River-Gulf Outlet, New Lock and Connecting Channels Evaluation Report*.

The 1997 Evaluation Report included an existing water quality investigation and elutriate analysis presented in Volume 3, Appendix B. Within this investigation, several resources were used to assess the water quality conditions in and near the study area at that time. These resources included sampling stations of the CEMVN, USGS, the Louisiana Department of Health and Hospitals, and the Louisiana Department of Natural Resources. This investigation also included data from samples collected on May 10 and 11, 1993 by CEMVN at four locations within the IHNC.

The existing water quality data reviewed for the 1997 report indicated problems with dissolved oxygen concentrations, coliform, pH, heavy metals, organics, and some pesticides. The elutriate data collected from the four new sample locations for this report revealed the presence of several metals and organic compounds such as polycyclic aromatic hydrocarbons.

The 1997 Evaluation Report also provides an initial assessment of the existence or potential for hazardous, toxic, and radiological waste (HTRW) as well as a Sampling and Analysis Report for the Phase II (August 1995) investigation of the East Bank Industrial Area (EBIA) or the Total Environmental Restoration Contract Site (TERC) in Volume 5, Appendix C. The following are notes from the initial assessment:

Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS)

- There were nine named Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) sites within the project vicinity two Higher Priority, four Lower Priority, three No Further Action and zero National Priority List. Page C-7 of the report displays a list with descriptions of each.

LARIS (Louisiana Department of Environmental Quality's {DEQ's} version of the EPA's CERCLIS)

- Six sites identified that did not appear on CERCLIS list.
- The report indicates the inability to locate the LARIS sites due to lack of record keeping by DEQ.

Spill Reports

- See Table 3 of the report for records (p. C-15) from ~1985 to 1993. All spills reported within ~1 to 2 miles from center of IHNC. Note subsequent spill reports beyond 1993 were investigated for this Tier I investigation.

Resource Conservation and Recovery Act (RCRA) (Louisiana Records)

- Report says the RCRA only accounts for new compliance items and large facilities. CEMVN did not receive information (full history) from DEQ in time for inclusion in the report. The report only addressed sites on the canal or with a compliance history.
- See Table 7, p. C-28 for "RCRA Notifiers in Close Proximity to Project Area."
- See p. C-34 for description of researched sites.

Underground Storage Tanks (USTs)

- See Table 8, p. C-40 for active USTs w/in the project area.
- Most USTs on list are for gas and diesel storage.

Port of New Orleans

- Table 14 lists companies along the IHNC as recorded by the Port of New Orleans in 1990.

Land Use History

- Report focuses on areas of most probable excavation. See p. C-68 for detail of these.
- See A Land Use History of Areas Adjacent to the Inner Harbor Navigation Canal Lock, New Orleans. Final Report. November 1992. (Prepared by R. Christopher Goodwin & Associates, Inc.) for more detail of the land use history.

No new COCs were found in the documentation that did not already appear on the COC list.

C. *Land Use History of Areas Adjacent to the Inner Harbor Navigation Canal Lock, New Orleans*

This report was prepared in 1992 and compiled as much historical data of the project area as possible for identification of potential, adverse environmental conditions. The report authors researched the following for information: 1) Sanborn Fire Insurance Maps: 2) city directories: and 3) records from environmental agencies.

The report summary indicates a concern that no information or records exist in environmental agencies (state or federal) for the following:

- Flintkote Asbestos Mill (1946 – 1957) @ block 854 near Galvez St. wharf
- Keasbey and Mattison (1946 – 1952) @ site of American Marine Corporation, which produced corrugated asbestos products.

Asbestos was detected in the EBIA surface soils (0-3 ft); therefore, asbestos was added to the SAP COC list. No other new COCs were found in the documentation that did not already appear on the COC list.

D. *Inner Harbor Navigation Canal Lock Replacement Project – Design Documentation Report No.1, Site Preparation and Demolition, Volume 6*

This report was completed prior to the TERC contract beginning. This report provided an initial site assessment for the designated TERC area. A COC list was developed for the TERC site. These compounds appear on the SAP COC list.

E. *Risk Evaluation/Corrective Action Program (RECAP) Submittal Report – Criteria Document IHNC East Bank Industrial Area (EBIA) New Orleans, LA,* June 2001

This report was prepared and submitted to DEQ in 2001 for the EBIA or TERC site. This document provided the framework for RECAP submittals that are being generated after sampling and analyzing the media at the six facilities that comprise the EBIA. Table 5 of the report lists the chemicals detected at the EBIA in the following media:

- Presence in Surface Soil 0-3 ft
- Presence in Potential Surface Soil 3-15 ft
- Presence in Sub-Surface Soil 15-36 ft
- Presence in Bank/Sediments
- Presence in Groundwater

Thirteen chemicals from Table 5 were added to the SAP COC list.

F. National Pollutant Discharge Elimination System (NPDES)/Louisiana Pollutant Discharge Elimination System(LPDES) Permit Files

Permit files were requested from DEQ in February of 2003. The request included current and historical facilities located on the IHNC and permitted to discharge into the IHNC. These files were received by CEMVN and reviewed for potential additional COCs. The permit files did not reveal any COCs that were not already on the list.

G. and H. *Other Sampling Efforts*

The results of sampling and analyses performed by the Port of New Orleans for the Florida Avenue Bridge Replacement and the Lake Pontchartrain Basin Foundation were reviewed for additional

contaminants that should be added to the SAP COC list. The constituents detected by these other efforts already appear on the COC list; therefore, there were no new COCs to add to the list. In 2005, the CEMVN conducted additional Tier III tests on sediments collected in the IHNC near the Florida Ave. Bridge (non-native sediments within IHNC lock replacement dredged material management units 1 and 2 NN). Based on poor survival of benthic organisms and proximity of sediment collection sites to suspected areas of contamination, sediments excavated as part of the lock replacement project from management units 1 and 2 were determined to be unsuitable for open-water placement. Therefore, further Tier III benthic testing was not proposed as part of the lock replacement SAP.

Based on review of the aforementioned existing information, a list of contaminants of concern has been developed and is included in this appendix (Table A1). The list includes target detection limits for sediment, tissue, and water.

Table A1. IHNC project-specific COC list and associated target detection limits for sediment, tissue, and water. [a]

	Target Detection Limits		
Contaminants of Concern (COC)	Sediment	Tissue	Water
Metals and Cyanide	(mg/kg)	(mg/kg)	(µg/L)
Aluminum	50	1	40
Antimony (Total)	2.5	0.1	3
Arsenic (Total)	0.3b	0.1	1
Barium	2	10	10
Calcium	5g	350b	5000g
Beryllium (Total)	1b	0.1	0.2
Cadmium (Total)	0.1	0.1	0.01c
Chromium (Total)	1b	0.05b	1
Chromium +3	1	50	1
Chromium +6	1	50	1
Copper (Total)	1b	0.1	1
Cyanide (Total)	2	1	0.1d
Lead (Total)	0.3b	0.1	0.02c
Mercury (Total)	0.2	0.01	0.0002
Nickel (Total)	0.5b	0.1	1
Selinium (Total)	0.5b	0.2	2
Silver (Total)	0.2	0.1	1
Thallium (Total)	0.2	0.1	0.02c
Tin (Organotin)	0.01	0.01	0.01
Tin (Total)	0.01	0.01	0.01
Zinc (Total)	2b	0.1b	1
Base/Neutral compounds	(µg/kg)	(µg/kg)	(µg/L)
1,2,4-Trichlorobenzene	10	20	0.9b
1,2-Dichlorobenzene	20	20	0.8b
1,2-Diphenylhydrazine	10	100	1
1,3-Dichlorobenzene	20	20	0.9b
1,4-Dichlorobenzene	20	20	1b
2,4-Dinitrotoluene	200b	200	2b
2,6-Dinitrotoluene	200b	200	2b
2-Chloronapthalene	160b	160	0.8b
2-Methylnaphthalene	20b	20b	0.5b
3,3'-Dichlorobenzidine	300b	300	3b
4-Bromophenyl phenyl ether	160b	160	0.4b
4-Chlorophenyl phenyl ether	170b	170	0.6b
Acenaphthene	20	20	0.75b
Acenaphthylene	20	20	1.0b
Anthracene	20	20	0.6b

Contaminants of Concern (COC)	Target Detection Limits		
	Sediment	Tissue	Water
Benzidine	5	5	1
Benzo(a)anthracene	20	20	0.4[b]
Benzo(a)pyrene	20	20	0.3[b]
Benzo(ghi)perylene	20	20	1.2[b]
Benzo(k)fluoranthene	20	20	0.6[b]
Bis(2-Chloroethoxy)methane	130[b]	130	1[b]
Bis(2-chloroethyl)ether	130[b]	130	0.9[b]
Bis(2-chloroisopropyl)ether	140[b]	200	0.7[b]
Bis(2-ethylhexyl)Phthalate	50	20	2[b]
Butyl Benzyl Phthalate	50	20	4[b]
Chrysene	20	20	0.3[b]
Dibenzo(a,h)anthracene	20	20	1.3[b]
Dibenzofuran	40[b]	100[b]	1[b]
Dimethyl Phthalate	50	20	1[b]
Di-n-butyl Phthalate	50	20	1[b]
Di-n-octyl Phthalate	50	20	3[b]
Fluoranthene	20	20	0.9[b]
Fluorene	20	20	0.6[b]
Hexachlorobenzene	10	20	0.4[b]
Hexachlorobutadiene	20	40	0.01
Hexachlorocyclopentadiene	300[b]	300	3.0[b]
Hexachloroethane	100	40	0.9[b]
Indeno(1,2,3-cd)pyrene	20	20	1.2[b]
Isophorone	10	100	1
Naphthalene	20	20	0.8[b]
Nitrobenzene	160[b]	160	0.9[b]
N-nitrosodimethylamine	100	100	3.1[b]
N-nitrosodi-n-propylamine	150[b]	150	0.9[b]
N-nitrosodiphenylamine	20	20	2.1[b]
Phenanthrene	20	20	0.5[b]
Pyrene	20	20	1.5[b]
Volatile compounds	**(µg/kg)**	**(µg/kg)**	**(µg/L)**
1,1,1-Trichloroethane	2		2
1,1,2,2-Tetrachloroethane	2		2
1,1,2-Trichloroethane	2		2
1,1-Dichloroethane	2		2
1,1-Dichloroethylene	2		2
1,2 Dichloroethene	2[b]		0.5[b]
1,2,4-Trimethylbenzene	2[b]		0.5[b]
1,2-Dichloroethane	2		2

Contaminants of Concern (COC)	Target Detection Limits		
	Sediment	Tissue	Water
Volatile compounds (cont)	(µg/kg)	(µg/kg)	(µg/L)
1,2-Dichloropropane	2		2
1,3,5-Trimethylbenzene	2[b]		0.5[b]
1,3-Dichloropropylene	2		2
2-Butanone	2[b]		0.5[b]
2-Chloroethyl Vinyl Ether	100		2
2-hexanone (methyl-n-butyl ketone)	2[b]		0.5[b]
4-Methyl-2-pentanone	2[b]		0.5[b]
Acetone	5[b]		5[b]
Acrolein	100		100
Acrylonitrile	100		100
Benzene	2		2[b]
Bromoform	2		2
Carbon Disulfide	2[b]		0.5[b]
Carbon Tetrachloride	2		2
Chlorobenzene	5		5
Chlorodibromomethane	2		2
Chloroethane	2		2
Chloroform	2		2[b]
Cis-1,3-Dichloropropene	2[b]		0.5[b]
Dichlorobromomethane	2		2
Ethylbenzene	5		5
Isopropylbenzene	2[b]		0.5[b]
Methyl Bromide	5		5
Methyl Chloride	5		5
Methylene Chloride	5		5
p-Isopropyltoluene	2[b]		0.5[b]
sec-Butylbenzene	2[b]		0.5[b]
Styrene	2[b]		0.5[b]
Tetrachloroethylene	2		2b
Toluene	5		5
trans-1,2-Dichloroethylene	2		2
Trichloroethylene	2		2[b]
Vinyl Chloride	5		5
Xylene	2[b]		1[b]
2,4,6-Trichlorophenol	60	60	0.9[b]
2,4-Dichlorophenol	60	60	0.8[b]
2,4-Dimethylphenol	20	20	10
2,4-Dinitrophenol	500[b]	500	5[b]
2-Chlorophenol	110[b]	110	0.9[b]

Contaminants of Concern (COC)	Target Detection Limits		
	Sediment	Tissue	Water
Volatile compounds (cont)	**(µg/kg)**	**(µg/kg)**	**(µg/L)**
2-Nitrophenol	200[b]	200	2[b]
4,6-Dinitro-o-Cresol	600	600	10
4-methylphenol	33[b]	20[b]	1[b]
4-Nitrophenol	500[b]	500	5[b]
Benzoic Acid	100[b]	100[b]	5[b]
Acid compounds	(µg/kg)	(µg/kg)	(µg/L)
p-Chloro-m-Cresol	140[b]	140	0.7[b]
Pentachlorophenol	100	100	0.2
Phenol	100	20	5
Pesticides / Hherbicides / PCBs / TPH	**(µg/kg)**	**(µg/kg)**	**(µg/L)**
2,4,5-T	20[e]		1.5[b]
2,4,5-TP	20[e]		1.5[b]
2,4-D	80[e]		15[b]
2,4-DB	80[e]		15[b]
4,4'-DDD [p,p-TDE]	2	10	0.0001
4,4'-DDE [p,p-DDX]	2	10	0.005
4,4'-DDT	2	10	0.00005
Aldrin	1	6[b]	0.01
Alpha -BHC	1	6[b]	0.01
Alpha-endosulfan	1	10	0.0009
Beta-BHC	1	6[b]	0.01
Beta-endosulfan	2	10	0.0009
BTEX (total)	3[b]		3[b]
Chlordane (alpha or gamma)	1	6[b]	0.0004
Dalapon	40[e]		2[e]
Delta-BHC	1	6[b]	0.01
Diazinon	48	0.1	0.1
Dicamba	40[e]		4.5[b]
Dichloroprop	10[b]		1.5[b]
Dieldrin	2	10	0.0002
Dinoseb	12[e]		3[b]
Endosulfan I	0.4[b]		0.01[b]
Endosulfan II	0.4[b]		0.01[b]
Endosulfan sulfate	2	10	0.0009
Endrin	2	10	0.0002
Endrin aldehyde	2	10	0.02
Gamma-BHC [Lindane]	1	6[b]	0.01
Heptachlor	1	6[b]	0.0004
Heptachlor epoxide	1	6[b]	0.0004

Contaminants of Concern (COC)	Target Detection Limits		
	Sediment	Tissue	Water
Pesticides / Hherbicides / PCBs / TPH (cont)	**(µg/kg)**	**(µg/kg)**	**(µg/L)**
MCPA	50[b]		1[b]
MCPP	50[b]		400[e]
Methoxychlor	3.3[b]	10[b]	0.1[b]
PCB-1016	1	2	0.01
PCB-1221	1	2	0.01
PCB-1232	1	2	0.01
PCB-1242	1	2	0.01
PCB-1248	1	2	0.01
PCB-1254	1	2	0.01
PCB-1260	1	2	0.01
Total PCBs	1	2	0.01
Technical chlordane	20	20	0.2
Toxaphene	20	50	0.00002
TPH-D	30000[f]		250[f]
TPH-G	100[f]		100[f]
TPH-O	50000		1000
Conventional Parameters / Other	**(µg/kg)**	**(µg/kg)**	**(µg/L)**
Ammonia	0.1	-	0.03
Atterberg Limits	-	-	-
Dissolved Organic Carbon	-	-	-
Grain Size	1%	-	-
In Situ Solid Concentration	-	-	-
In Situ Water Content	-	-	-
Percent Solids/Total Solids	0.10%	-	-
Specific Gravity	-	-	-
TOC	0.10%	-	0.10%
Total Lipid (Tissue)	-	0.1%g	-
Other	**MFL**		**MFL**
Asbestos	1		7

MFL=million fibers/liter

a The primary source of these TDLs was EPA 823-B-95-001, QA/QC Guidance for Sampling and Analysis of Sediments, Water and Tissues for Dredged Material Evaluations.

b These values are based on recommendations from the EPA Region 6 Laboratory in Houston and were based on data or other technical information.

c The values in parentheses are based on EPA "clean techniques", (EPA 1660 series methods), which are applicable in instances where other TDLs are inadequate to assess EPA water quality criteria.

d This value recommended by Houston Lab using colorimetric method.

e Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, 3rd ed., December 1996.

f These values are based on recommendations from the EPA Region 8 Laboratory in Golden, Colorado.

g Sweat, M.J. 1999. USGS administrative report.

Appendix B: Comparison of Dredged Elutriate Results to Standards and Calculation of Mixing Zones

Objectives

The dredging elutriate test (DRET) is described in DiGiano, Miller and Yoon (1995). The DRET test was developed to assess water quality impacts associated with release of contaminants during dredging at the dredging site. Point of disposal versus point of dredging differs with respect to concentration of suspended solids, which in turn affects the distribution of contaminants between solid and aqueous phases. The maximum TSS concentration at the point of dredging is typically less than 10,000 mg/L (DiGiano, Miller and Yoon (1995) or a solids-to-water volumetric ratio of 1:250 (as compared to roughly 1:4 for the standard elutriate test and 1:17 for the modified elutriate test). The DRET test is similar to the other two elutriate tests in that site water is used to slurry the in situ sediments, the slurry is aerated for a specified period, and the supernatant is measured for total and dissolved contaminant concentrations and TSS. An initial concentration of 10 g/L was used for the IHNC sediments.

According to the ITM (U.S. Environmental Protection Agency/U.S. Army Corps of Engineers (USEPA/USACE) 1998), "material re-suspended during normal dredging operations is considered "de minimus" and is not regulated under Section 404 as a dredged material discharge. The potential impact of re-suspension due to dredging can be addressed under NEPA." Of particular concern to the community with respect to the IHNC dredging is the potential for transport of suspended solids and contaminants to Lake Ponchartrain during dredging. Results of the DRET test were used in conjunction with modeling of SS using the DREDGE[1] model, in order to predict distance to compliance with applicable water quality criteria from the point of dredging.

[1] http://el.erdc.usace.army.mil/products.cfm?Topic=model&Type=drgmat

Data evaluation and dilution requirements

Dredging elutriates were prepared for both freshwater and marine locations of the IHNC and analyzed by Test America (Weston Soulutions, Inc. 2008) for total and dissolved contaminant concentrations. Results obtained for total and dissolved elutriate fractions are summarized here. The raw data for both total and dissolved fractions are reported in Weston Solutions, Inc.(2008).

Dissolved phase elutriate concentrations were compared to applicable WQC for all contaminants (both organic compounds and metals) as this is considered to be the bioavailable phase. Toxicity testing was not conducted on dredging elutriates; however, toxicity testing conducted on freshwater and marine standard elutriates could be considered conservatively representative of the dredging elutriates. The SE toxicity testing would be considered to be conservative because of the higher suspended solids concentrations in the SE test (~150 g/L vs. 10 g/L in the dredging elutriate) and the higher initial dilution expected at the dredge. A reasonable interpretation might be to multiply the dilution obtained using the LC50 from the SE toxicity tests by 0.15 (the ratio of the initial solids concentrations) or by the ratio of the measured elutriate concentrations. The ratio of dredge to standard elutriates concentrations was as follows: mean 0.73, geometric mean 0.88, maximum 0.45. Because the maximum dilution obtained in standard elutriate testing is being utilized, the ratio of the maximum concentrations was selected (0.45). Applying the factor to the maximum LC50 obtained in the freshwater SE testing (384) yields a maximum dilution requirement for the freshwater dredging elutriate of 195. For the marine elutriates, no LC50 could be calculated (LC50 was predicted to be greater than the 100% dilution).

In this case, some sites that are presently marine in character are expected to be freshwater when dredging takes place (once the old lock is opened permanently). This may impact portions of DMMUs 9 and 10 in particular. The importance of this is that the higher ionic strength of saltwater limits the activity of contaminants to some degree, which may in turn result in reduced dissolved concentrations in the elutriate testing. The magnitude of this effect is expected to range from approximately 5% to 20%, based on a preliminary evaluation using the Setschenow equation and Setschenow constants available for contaminants present in the IHNC. This is not enough to alter dilution requirements any more than the sediment variability itself, but is mentioned here for completeness.

Mean (arithmetic and geometric) and maximum contaminant concentrations were determined for each constituent, utilizing the dredging elutriate results obtained from all DMMUs (Tables B1 through B4). Data rejected in the data validation for eight samples and seven compounds (Table B5). As for the other elutriate tests, a value of half the reporting limit (0.5RL) was assumed for all non-detects in calculating the means. Where the maximum elutriate concentration was less than the laboratory reporting limit (RL) for that sample, the highest qualified value was taken as the maximum. Where the maximum elutriate concentration was less than the RL *and* there were no qualified values (all samples were non-detect), the compound was assumed not to be present, and dilutions were not reported. Partitioning analysis could be used to predict dissolved concentrations in those cases, but the assumption of 0.5RL should be conservative, since the results would not have been qualified as a non-detect if the compound were detected above 0.5RL. Dilutions calculated using 0.5RL as the maximum confirmed that they were not controlling, and these were therefore not included in the report.

The DREDGE model enables determination of the dilution available within a water body based on evaluation of predicted TSS in the water column, without settling. Model results are applied to calculate TSS remaining in the water as a function of distance from the dredge, taking into account both effects of dilution and settling. A partitioning coefficient, calculated using the maximum dredging elutriate data and the sediment chemistry, allows determination of the fraction dissolved and can be used with the predicted TSS level to calculate a new equilibrium concentration at the point of interest.

Flow conditions and geometry specific to the IHNC were used in the model, based on information provided by MVN. The following model assumptions were used:

- Water depth 11 m
- Velocity 0.61 cm/sec
- Lateral diffusion coefficient 60 cm^2/sec
- Vertical diffusion coefficient 5 cm^2/sec
- Modeling domain 400 m long and 100 m wide
- Source rate 0.22 kg/sec of solids
- Production rate 900 cy/hr
- Solids loss 0.1%

Concentrations were estimated at the bottom of the water column and 1 m above the bottom. Distance to compliance with the most conservative of acute and chronic Federal marine or State of Louisiana marine or brackish water quality criteria was calculated. Where no such criteria existed, EPA Region 4 water quality screening criteria for hazardous waste sites were used, if available. Distance to achieve a dilution of 195, as extrapolated from the freshwater SE toxicity testing, was also calculated.

Mixing

Distance to compliance with water quality criteria for marine dredging elutriates are listed in Table B6 and for freshwater dredging elutriates in Table B7. For marine elutriates, maximum distance to meet acute criteria was less than 25 m (total cyanide), and maximum distance to meet chronic criteria was <350 m (total PCBs).

For freshwater elutriates, maximum distance to meet acute criteria was less than 1 m for most constituents. Maximum distance to meet chronic criteria for freshwater elutriates was <38 m (mercury). Maximum distance to achieve a dilution ratio of 195 required based on freshwater toxicity (extrapolated to dredging elutriate from standard elutriate) was <200 m (for both 0 m and 1 m above the bottom).

Turbidity limits for estuarine lakes, bays, bayous, and canals are given in LAC 33:IX.§1113.B.9 (a) and (b)(ii). It is specified that “turbidity other than that of natural origin shall not cause substantial visual contrast with the natural appearance of the waters of the state or impair any designated water use. Turbidity shall not significantly exceed background; background is defined as the natural condition of the water. Determination of background will be on a case-by-case basis.” The numerical turbidity limit for these water bodies is 50 NTU.

Background TSS was measured as part of the surface water quality analysis and ranged from 3.6 mg/L to 30.8 mg/L. Correspondence of TSS to turbidity was evaluated in the column settling tests reported in Weston Soulutions, Inc.(2008). The relationship is linear according to the following equation:

$$TSS = xTurbidity$$

where:

TSS =total suspended solids concentration (mg/L)
Turbidity=measured turbidity (NTU)

For the sediments tested, the coefficient x ranges from 0.819 to 1.64. To meet a turbidity limit of 50 NTU, maximum allowable TSS would therefore range from 42.5 mg/L to 82.0 mg/L. Based on the DREDGE modeling, at 0 depth above the bottom, TSS will be <45 mg/L at 100 m from the dredge. At a depth of 1 m above the bottom, TSS are predicted to be <32 mg/L 100 m from the dredge. (Differences in salinity could be considered in modeling movement of suspended solids away from the dredge, but in this case no data are available to suggest that there is a significant salinity gradient within the IHNC or to permit estimation of effects on settling rate. Salinity considerations should be of secondary importance since the goal is primarily estimation of dissolved contaminant concentration, and this is more strongly a function of source strength and partitioning than settling. No adjustments were therefore made in the DREDGE modeling to account for salinity differences in the different locations of the IHNC.)

Although background TSS will be exceeded for a moderate distance from the dredge location, turbidity induced by a hydraulic dredge will not be visible at the surface and should not "cause substantial visual contrast" in violation of LA WQC. In addition, LAC 33:IX.§1113.B.9 (c) specifies: "The administrative authority may exempt for short periods certain activities permitted under Sections 402 or 404 and certified under Section 401 of the Clean Water Act, such as maintenance dredging of navigable waterways or other short-term activities that the state determines are necessary to accommodate legitimate uses or emergencies or to protect the public health and welfare." Based on this and expected dilution of dissolved constituents, water column impacts associated with the dredging should not be unacceptable from a regulatory perspective.

Conclusions

Based on evaluation of the dredged elutriate results and anticipated dilution in the IHNC, water column impacts associated with dredging should not be unacceptable from an environmental or regulatory perspective. For marine elutriates, maximum distance to meet acute criteria was < 25 m (from the dredge) and to meet chronic criteria <350 m. For freshwater elutriates, maximum distance to meet acute criteria was < 1 m (from the dredge) and to meet chronic criteria < 30 m. TSS

objectives, and by inference turbidity objectives, are expected to be met within 100 m of the dredge and may be exempted from state criteria for purposes of dredging in any case, as specified in the state water quality regulations. Maximum distance to meet a dilution of 195 (based on toxicity testing) was <200 m at the bottom and at 1m above the bottom.

References

DiGiano, F.A., C.T. Miller, and J. Yoon. 1995. *Dredging elutriate test (DRET) development*. Contract Report D-95-1. Vicksburg, MS: U.S. Army Corps of Engineers, Waterways Experiment Station.

U.S. Environmental Protection Agency / U.S. Army Corps of Engineers (USEPA/USACE). 1998. *Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S. - Testing Manual (Inland Testing Manual).* EPA 823-B-98-004. Washington, DC: Office of Water.

Weston Solutions, Inc. 2008. *Inner Harbor Navigation Canal Evaluation of Material Generated from Lock Construction. New Orleans, Louisiana*. Prepared for the U.S. Army Engineer District, Tulsa, OK, and the U.S. Army Engineer District, New Orleans, LA. Contract No. W912BV-04-D-2026.

Table B1. Dredging elutriate results - dissolved fraction (freshwater).

Component Name	Mean	Geomean	Maximum	Units	MDL	RL	Qualifier	Sample
Group I: Maximum Value Above RL								
Aldrin	0.00791	0.00496	0.014	µg/L	0.00053	0.0025	PG N	10_C3&4 - FN
Aluminum	707	435	1930	µg/L	6.1	150	J	10_C3&4 - FN
Ammonia as Nitrogen	0.260	0.220	0.4	mg/L	0.0094	0.1	J	9_1 - NN
Barium	99.7	99.2	115	µg/L	0.38	50		9_C2&4 - NN
Calcium	49240	46858	84400	µg/L	31.3	500		9_C2&4 - NN
gamma-BHC (Lindane)	0.00378	0.00319	0.0066	µg/L	0.00075	0.0026	PG N	9_C2&4 - NN
Heptachlor	0.0108	0.00317	0.047	µg/L	0.00066	0.0025	PG N	10_1 - NN
pH	8.00	8.00	8.2	No Units				10_C3&4 - FN
Total Organic Carbon	3.64	3.63	3.8	mg/L				10_C3&4 - FN
Total Suspended Solids	4.40	3.84	7	mg/L	3.4	4		9_C2&4 - NN
TPH (as Diesel)	80.0	71.9	140	µg/L	47	100	B	9_C2&4 - NN
Chromium III	5.64	5.45	7.5	µg/L	0.27	2		9_1 - NN
Group II: Maximum Value <RL, Some Qualified Values Reported								
4,4'-DDD	0.00112	0.00107	0.00056[a]	µg/L	0.00038	0.0026	J	9_C2&4 - NN
4,4'-DDT	0.00160	0.00155	0.0023	µg/L	0.00065	0.0025	J PG	10_1 - NN
Arsenic	3.02	2.95	4.2	µg/L	0.7	5	B	10_C3&4 - FN
bis(2-Ethylhexyl) phthalate	0.298	0.264	0.51	µg/L	0.11	0.96	J	10_1 - NN
Chromium	5.54	5.38	6.9	µg/L	0.56	10	B J	9_C2&4 - NN
Copper	3.02	2.82	4.7	µg/L	0.7	10	B	10_C3&4 - FN
Cyanide, Total	4.56	4.36	5.5	µg/L	1.7	10	B J	9_1 - NN
Endrin	0.00124	0.00124	0.0011	µg/L	0.00036	0.0025	J PG	10_1 - NN

Component Name	Mean	Geomean	Maximum	Units	MDL	RL	Qualifier	Sample
gamma-Chlordane	0.00152	0.00146	0.0025	µg/L	0.00036	0.0025	PG	10_C3&4 - FN
Lead	0.890	0.646	1.8	µg/L	0.1	5	B J	10_C3&4 - FN
Mercury	0.0918	0.0900	0.059	µg/L	0.055	0.2	B	9_C2&4 - NN
Nickel	2.30	2.18	3.2	µg/L	0.36	5	B	10_C3&4 - FN
Phenanthrene	0.0922	0.0915	0.071	µg/L	0.054	0.2	J	10_C3&4 - F
Selenium	4.48	3.70	10.1	µg/L	1	25	B	9_C2&4 - NN
Thallium	1.088	0.448	0.2	µg/L	0.09	5	B J	9_C2&4 - NN
TPH (as Gasoline)	43.4	42.6	50	µg/L	28	100	J	10_C3&4 - F
Zinc	11.6	10.9	17.3	µg/L	3	25	B	10_C3&4 - F
Group III: All Samples Non-Detect								
1,2,4-Trichlorobenzene	0.0980	0.0980	0.1	µg/L	0.039	0.2	U	
1,2-Dichlorobenzene	0.0980	0.0980	0.1	µg/L	0.031	0.2	U	
1,2-Diphenylhydrazine	0.0980	0.0980	0.1	µg/L	0.044	0.2	U	
1,3-Dichlorobenzene	0.0980	0.0980	0.1	µg/L	0.036	0.2	U	
1,4-Dichlorobenzene	0.0980	0.0980	0.1	µg/L	0.047	0.2	U	
2,2'-oxybis(1-Chloropropane)	0.0980	0.0980	0.1	µg/L	0.025	0.2	U	
2,4,5-T	0.500	0.500	0.5	µg/L	0.17	1	U	
2,4,5-TP (Silvex)	0.500	0.500	0.5	µg/L	0.16	1	U	
2,4,6-Trichlorophenol	0.488	0.488	0.5	µg/L	0.058	1	U	
2,4-D	2.00	2.00	2	µg/L	1.5	4	U	
2,4-DB	2.00	2.00	2	µg/L	0.59	4	U	
2,4-Dichlorophenol	0.0980	0.0980	0.1	µg/L	0.048	0.2	U	
2,4-Dimethylphenol	0.488	0.488	0.5	µg/L	0.053	1	U	

Component Name	Mean	Geomean	Maximum	Units	MDL	RL	Qualifier	Sample
2,4-Dinitrophenol	2.46	2.46	2.55	µg/L	1.3	5.1	U	
2,4-Dinitrotoluene	0.488	0.488	0.5	µg/L	0.046	1	U	
2,6-Dinitrotoluene	0.488	0.488	0.5	µg/L	0.052	1	U	
2-Chloronaphthalene	0.0980	0.0980	0.1	µg/L	0.043	0.2	U	
2-Chlorophenol	0.488	0.488	0.5	µg/L	0.046	1	U	
2-Methylnaphthalene	0.0980	0.0980	0.1	µg/L	0.046	0.2	U	
2-Nitrophenol	0.488	0.488	0.5	µg/L	0.055	1	U	
3,3'-Dichlorobenzidine	0.488	0.488	0.5	µg/L	0.042	1	U	
4,4'-DDE	0.00127	0.00127	0.0013	µg/L	0.00033	0.0026	U	
4,6-Dinitro-2-methylphenol	2.46	2.46	2.55	µg/L	1.4	5.1	U	
4-Bromophenyl phenyl ether	0.488	0.488	0.5	µg/L	0.051	1	U	
4-Chloro-3-methylphenol	0.488	0.488	0.5	µg/L	0.06	1	U	
4-Chlorophenyl phenyl ether	0.488	0.488	0.5	µg/L	0.043	1	U	
4-Methylphenol	0.488	0.488	0.5	µg/L	0.075	1	U	
4-Nitrophenol	2.46	2.46	2.55	µg/L	0.072	5.1	U	
Acenaphthene	0.0980	0.0980	0.1	µg/L	0.051	0.2	U	
Acenaphthylene	0.0980	0.0980	0.1	µg/L	0.045	0.2	U	
alpha-BHC	0.00127	0.00127	0.0013	µg/L	0.00075	0.0026	U	
alpha-Chlordane	0.00127	0.00127	0.0013	µg/L	0.00056	0.0026	U	
Anthracene	0.0980	0.0980	0.1	µg/L	0.05	0.2	U	
Antimony	5.00	5.00	5	µg/L	0.24	10	U	
Aroclor 1016	0.00970	0.00970	0.01	µg/L	0.005	0.02	U	
Aroclor 1221	0.00970	0.00970	0.01	µg/L	0.0049	0.02	U	

Component Name	Mean	Geomean	Maximum	Units	MDL	RL	Qualifier	Sample
Aroclor 1232	0.00970	0.00970	0.01	µg/L	0.0058	0.02	U	
Aroclor 1242	0.00970	0.00970	0.01	µg/L	0.0037	0.02	U	
Aroclor 1248	0.00970	0.00970	0.01	µg/L	0.0045	0.02	U	
Aroclor 1254	0.00970	0.00970	0.01	µg/L	0.0045	0.02	U	
Aroclor 1260	0.00970	0.00970	0.01	µg/L	0.0027	0.02	U	
Aroclors (Total)	0.00970	0.00970	0.01	µg/L	0.0058	0.02	U	
Benzidine	9.80	9.80	10	µg/L	5.5	20	U	
Benzo(a)anthracene	0.0980	0.0980	0.1	µg/L	0.04	0.2	U	
Benzo(a)pyrene	0.0980	0.0980	0.1	µg/L	0.043	0.2	U	
Benzo(b)fluoranthene	0.0980	0.0980	0.1	µg/L	0.031	0.2	U	
Benzo(ghi)perylene	0.0980	0.0980	0.1	µg/L	0.027	0.2	U	
Benzo(k)fluoranthene	0.0980	0.0980	0.1	µg/L	0.039	0.2	U	
Benzoic acid	2.46	2.46	2.55	µg/L	0.43	5.1	U	
Beryllium	2.50	2.50	2.5	µg/L	0.34	5	U	
beta-BHC	0.00127	0.00127	0.0013	µg/L	0.00072	0.0026	U	
bis(2-Chloroethoxy)methane	0.488	0.488	0.5	µg/L	0.12	1	U	
bis(2-Chloroethyl) ether	0.0980	0.0980	0.1	µg/L	0.045	0.2	U	
Butyl benzyl phthalate	0.488	0.488	0.5	µg/L	0.14	1	U	
Cadmium	2.50	2.50	2.5	µg/L	0.53	5	U	
Chlordane (technical)	0.0122	0.0122	0.0125	µg/L	0.0074	0.025	U	
Chrysene	0.0980	0.0980	0.1	µg/L	0.035	0.2	U	
Chromium VI	0.00500	0.00500	0.005	mg/L	0.0026	0.01	U	
Dalapon	1.00	1.00	1	µg/L	0.52	2	U	

Component Name	Mean	Geomean	Maximum	Units	MDL	RL	Qualifier	Sample
delta-BHC	0.00127	0.00127	0.0013	µg/L	0.00047	0.0026	U	
Diazinon	0.486	0.486	0.5	µg/L	0.12	1	U	
Dibenz(a,h)anthracene	0.0980	0.0980	0.1	µg/L	0.034	0.2	U	
Dibenzofuran	0.488	0.488	0.5	µg/L	0.055	1	U	
Dibutyltin	0.0190	0.0190	0.0195	µg/L	0.01	0.039	U	
Dicamba	1.00	1.00	1	µg/L	0.33	2	U	
Dichlorprop	2.00	2.00	2	µg/L	0.72	4	U	
Dieldrin	0.00127	0.00127	0.0013	µg/L	0.0004	0.0026	U	
Diethyl phthalate	0.488	0.488	0.5	µg/L	0.25	1	U	
Dimethyl phthalate	0.488	0.488	0.5	µg/L	0.043	1	U	
Di-n-butyl phthalate	0.488	0.488	0.5	µg/L	0.047	1	U	
Di-n-octyl phthalate	0.488	0.488	0.5	µg/L	0.043	1	U	
Dinoseb	0.3	0.3	0.3	µg/L	0.26	0.6	U	
Endosulfan I	0.00127	0.00127	0.0013	µg/L	0.00037	0.0026	U	
Endosulfan II	0.00127	0.00127	0.0013	µg/L	0.00075	0.0026	U	
Endosulfan sulfate	0.00127	0.00127	0.0013	µg/L	0.00079	0.0026	U	
Endrin aldehyde	0.00127	0.00127	0.0013	µg/L	0.0006	0.0026	U	
Fluoranthene	0.0980	0.0980	0.1	µg/L	0.048	0.2	U	
Fluorene	0.0980	0.0980	0.1	µg/L	0.053	0.2	U	
Heptachlor epoxide	0.00127	0.00127	0.0013	µg/L	0.00049	0.0026	U	
Hexachlorobenzene	0.0980	0.0980	0.1	µg/L	0.043	0.2	U	
Hexachlorobutadiene	0.0980	0.0980	0.1	µg/L	0.037	0.2	U	
Hexachlorocyclopentadiene	0.488	0.488	0.5	µg/L	0.082	1	U	

Component Name	Mean	Geomean	Maximum	Units	MDL	RL	Qualifier	Sample
Hexachloroethane	0.488	0.488	0.5	µg/L	0.044	1	U	
Indeno(1,2,3-cd)pyrene	0.0980	0.0980	0.1	µg/L	0.047	0.2	U	
Isophorone	0.488	0.488	0.5	µg/L	0.048	1	U	
MCPA	200	200	200	µg/L	94	400	U	
MCPP	200	200	200	µg/L	130	400	U	
Methoxychlor	0.00244	0.00244	0.0025	µg/L	0.00091	0.005	U	
Monobutyltin	0.248	0.248	0.255	µg/L	0.05	0.51	U	
Naphthalene	0.0980	0.0980	0.1	µg/L	0.042	0.2	U	
Nitrobenzene	0.0980	0.0980	0.1	µg/L	0.063	0.2	U	
N-Nitrosodimethylamine	0.488	0.488	0.5	µg/L	0.046	1	U	
N-Nitrosodi-n-propylamine	0.0980	0.0980	0.1	µg/L	0.058	0.2	U	
N-Nitrosodiphenylamine	0.0980	0.0980	0.1	µg/L	0.048	0.2	U	
Pentachlorophenol	0.488	0.488	0.5	µg/L	0.085	1	U	
Phenol	0.0980	0.0980	0.1	µg/L	0.022	0.2	U	
Pyrene	0.0980	0.0980	0.1	µg/L	0.055	0.2	U	
Silver	2.50	2.50	2.5	µg/L	0.39	5	U	
Tetrabutyltin	0.0248	0.0248	0.0255	µg/L	0.0086	0.051	U	
Tin	12.5	12.5	12.5	µg/L	3.8	25	U	
Toxaphene	0.00127	0.00127	0.0013	µg/L	0.00075	0.0026	U	
Tributyltin	0.0220	0.0220	0.0225	µg/L	0.012	0.045	U	

[a] Where the highest qualified value has been selected as the maximum, the mean is sometimes higher than the selected maximum value as a result of being inflated by the assumption of ½ the RL for non-detects. This occurs in cases where RL's vary from sample to sample and are lower for the qualified sample.

Table B2. Dredging elutriate results - dissolved fraction (marine).

Component Name	Mean	Geomean	Maximum	Units	MDL	RL	Qualifier	Sample
Group I: Maximum Value Above RL								
4,4'-DDT[1]	0.00158	0.00143	0.0031	µg/L	0.00066	0.0025		3_C1_3 - F
Aldrin	0.00521	0.00256	0.039	µg/L	0.0022	0.01	PG	10_C1_6 - NN
alpha-Chlordane[1]	0.00166	0.00148	0.0044	µg/L	0.00054	0.0025	PG	3_C1_3 - F
Aluminum	157	118	994	µg/L	6.1	150		7_6 - F
Ammonia as Nitrogen	0.386	0.334	1.8	mg/L	0.0094	0.1		6_2 - N
Aroclor 1248	0.0974	0.0163	1.9	µg/L	0.0044	0.019		5_6 - NN
Aroclor 1254	0.0840	0.0153	2.5	µg/L	0.0044	0.019		5_6 - NN
Aroclor 1260	0.0505	0.0140	1.3	µg/L	0.0026	0.019		5_6 - NN
Aroclors (Total)	0.216	0.0181	4.7	µg/L	0.0056	0.019		5_6 - NN
Arsenic	6.93	6.48	12.7	µg/L	0.7	5	J	10_C1_6 - NN
Barium	134	131	228	µg/L	0.38	50		6_4 - FN
beta-BHC	0.00325	0.00180	0.024	µg/L	0.00069	0.0025		6_2 - N
bis(2-Ethylhexyl) phthalate	0.540	0.479	1.4	µg/L	0.11	0.95		7_9 - F
Calcium	123000	122000	152000	µg/L	31.3	500		6_5 - F
Cyanide, Total	5.15	3.88	63.6	µg/L	1.7	10		6_2 - NN
delta-BHC	0.00735	0.00278	0.043	µg/L	0.00045	0.0025	PG N	6_5 - FN
Dibutyltin	0.0235	0.0207	0.15	µg/L	0.01	0.039		3_C4_6 - NN
Endosulfan II	0.00534	0.00322	0.019	µg/L	0.00072	0.0025	PG N	6_2 - N
Endosulfan sulfate	0.00162	0.00142	0.0071	µg/L	0.00076	0.0025	PG N	6_5 - FN
Endrin	0.00166	0.00138	0.0085	µg/L	0.00037	0.0025	PG N	3_C1_3 - F
Endrin aldehyde[1]	0.00158	0.00144	0.0027	µg/L	0.00057	0.0025		6_6 - F
gamma-BHC (Lindane)	0.00278	0.00239	0.0095	µg/L	0.00073	0.0025		7_9 - F

Component Name	Mean	Geomean	Maximum	Units	MDL	RL	Qualifier	Sample
gamma-Chlordane	0.00277	0.00223	0.0084	µg/L	0.00036	0.0025		6_2 - N
Heptachlor	0.0101	0.00518	0.053	µg/L	0.00066	0.0025	PG N	7_4 - NN
Heptachlor epoxide	0.00235	0.00164	0.028	µg/L	0.00047	0.0025	PG N	3_C1_3 - F
Nickel	4.04	2.98	59.5	µg/L	0.36	5		6_6 - FN
pH	7.80	7.79	8.5	No Units				4/5_C2_10 - N
Phenol	0.101	0.0994	0.27	µg/L	0.021	0.19		7_5 - F
Selenium	35.0	31.9	57.2	µg/L	1	25	E	10_C1_6 - NN
Tetrabutyltin	0.0252	0.0249	0.065	µg/L	0.0086	0.058	P	8_C1_4 - NN
Total Organic Carbon	2.91	2.89	5.1	mg/L				6_6 - F
Total Suspended Solids	5.21	3.56	36	mg/L	3.4	4		6_1 - N
TPH (as Diesel)	80.8	68.7	390	µg/L	47	100		3_C1_3 - F
Tributyltin	0.0341	0.0270	0.24	µg/L	0.012	0.043		4_4 - NN
Chromium III	6.58	6.34	9.8	µg/L	0.27	2		7_5 - F
Zinc	9.12	7.71	43.4	µg/L	3	25		3_C4_6 - N
Group II: Maximum Value <RL, Some Qualified Values Reported								
2-Methylnaphthalene	0.0967	0.0965	0.067	µg/L	0.044	0.19	J	7_9 - F
4,4'-DDD	0.00153	0.00140	0.0019	µg/L	0.00037	0.0025	J PG	5_6 - NN
4,4'-DDE	0.00149	0.00135	0.0021	µg/L	0.00032	0.0025	J PG	6_6 - F
4-Methylphenol	0.478	0.471	0.11	µg/L	0.069	0.94	J	6_1 - N
Acenaphthene	0.0964	0.0961	0.058	µg/L	0.052	0.2	J	2_C1_6 - NN
alpha-BHC	0.00159	0.00145	0.0021	µg/L	0.00072	0.0025	J	6_2 - N
Antimony	1.87	1.22	2	µg/L	0.24	10	B	6_4 - FN
Beryllium	1.41	1.24	2.6	µg/L	0.34	5	B	7_C1_9 - N

Component Name	Mean	Geomean	Maximum	Units	MDL	RL	Qualifier	Sample
Butyl benzyl phthalate	0.479	0.473	0.14	µg/L	0.13	0.94	J	6_1 - N
Cadmium	1.92	1.68	1.5	µg/L	0.53	5	B	6_4 - FN
Chromium	6.64	6.43	9.8	µg/L	0.56	10	B J	7_5 - F
Copper	2.70	2.62	5.5	µg/L	0.7	10	B	6_2 - NN
Dalapon	0.979	0.974	1	µg/L	0.52	2	J COL	4/5_5 - N
Dichlorprop	1.98	1.96	0.84	µg/L	0.72	4	J COL	5_5 - NN
Dieldrin	0.00153	0.00139	0.0021	µg/L	0.00038	0.0025	J PG	3_C1_3 - F
Endosulfan I	0.00147	0.00132	0.0018	µg/L	0.00035	0.0025	J PG N	6_6 - F
Fluoranthene	0.0969	0.0968	0.077	µg/L	0.048	0.19	J	4_4 - NN
Fluorene	0.0970	0.0969	0.087	µg/L	0.055	0.2	J	5_C1_3 - NN
Lead	0.618	0.527	1.4	µg/L	0.1	5	B	7_6 - F
Mercury	0.0993	0.0992	0.067	µg/L	0.055	0.2	B	3_C1_3 - FN
Phenanthrene	0.0960	0.0954	0.13	µg/L	0.056	0.2	J	5_C1_3 - NN
Thallium	1.38	0.834	1.9	µg/L	0.09	5	B J	3_C1_3 - FN
Tin	11.5	11.1	13.3	µg/L	3.8	25	B	3_C1_3 - FN
TPH (as Gasoline)	43.4	42.3	58	µg/L	28	100	J B	6_2 - NN
Group III: All Samples Non-Detect								
1,2,4-Trichlorobenzene	0.0973	0.0972	0.115	µg/L	0.045	0.23	U	
1,2-Dichlorobenzene	0.0973	0.0972	0.115	µg/L	0.036	0.23	U	
1,2-Diphenylhydrazine	0.0973	0.0972	0.115	µg/L	0.051	0.23	U	
1,3-Dichlorobenzene	0.0973	0.0972	0.115	µg/L	0.042	0.23	U	
1,4-Dichlorobenzene	0.0973	0.0972	0.115	µg/L	0.055	0.23	U	
2,2'-oxybis(1-Chloropropane)	0.0973	0.0972	0.115	µg/L	0.03	0.23	U	

Component Name	Mean	Geomean	Maximum	Units	MDL	RL	Qualifier	Sample
2,4,5-T	0.500	0.500	0.5	µg/L	0.17	1	U	
2,4,5-TP (Silvex)	0.500	0.500	0.5	µg/L	0.16	1	U	
2,4,6-Trichlorophenol	0.485	0.485	0.55	µg/L	0.065	1.1	U	
2,4-D	2.00	2.00	2	µg/L	1.5	4	U	
2,4-DB	2.00	2.00	2	µg/L	0.59	4	U	
2,4-Dichlorophenol	0.0973	0.0972	0.115	µg/L	0.055	0.23	U	
2,4-Dimethylphenol	0.485	0.485	0.55	µg/L	0.059	1.1	U	
2,4-Dinitrophenol	2.44	2.44	2.85	µg/L	1.5	5.7	U	
2,4-Dinitrotoluene	0.485	0.485	0.55	µg/L	0.051	1.1	U	
2,6-Dinitrotoluene	0.485	0.485	0.55	µg/L	0.058	1.1	U	
2-Chloronaphthalene	0.0973	0.0972	0.115	µg/L	0.05	0.23	U	
2-Chlorophenol	0.485	0.485	0.55	µg/L	0.052	1.1	U	
2-Nitrophenol	0.485	0.485	0.55	µg/L	0.062	1.1	U	
3,3'-Dichlorobenzidine	0.485	0.485	0.55	µg/L	0.047	1.1	U	
4,6-Dinitro-2-methylphenol	2.44	2.44	2.85	µg/L	1.6	5.7	U	
4-Bromophenyl phenyl ether	0.485	0.485	0.55	µg/L	0.056	1.1	U	
4-Chloro-3-methylphenol	0.485	0.485	0.55	µg/L	0.067	1.1	U	
4-Chlorophenyl phenyl ether	0.485	0.485	0.55	µg/L	0.049	1.1	U	
4-Nitrophenol	2.44	2.44	2.85	µg/L	0.08	5.7	U	
Acenaphthylene	0.0973	0.0972	0.115	µg/L	0.053	0.23	U	
Anthracene	0.0973	0.0972	0.115	µg/L	0.058	0.23	U	
Aroclor 1016	0.0115	0.0105	0.0405	µg/L	0.02	0.081	U	
Aroclor 1221	0.0115	0.0105	0.0405	µg/L	0.02	0.081	U	

Component Name	Mean	Geomean	Maximum	Units	MDL	RL	Qualifier	Sample
Aroclor 1232	0.0115	0.0105	0.0405	µg/L	0.024	0.081	U	
Aroclor 1242	0.0115	0.0105	0.0405	µg/L	0.015	0.081	U	
Benzidine	9.73	9.72	11.5	µg/L	6.4	23	U	
Benzo(a)anthracene	0.0973	0.0972	0.115	µg/L	0.047	0.23	U	
Benzo(a)pyrene	0.0973	0.0972	0.115	µg/L	0.05	0.23	U	
Benzo(b)fluoranthene	0.0973	0.0972	0.115	µg/L	0.036	0.23	U	
Benzo(ghi)perylene	0.0973	0.0972	0.115	µg/L	0.031	0.23	U	
Benzo(k)fluoranthene	0.0973	0.0972	0.115	µg/L	0.045	0.23	U	
Benzoic acid	2.44	2.44	2.85	µg/L	0.48	5.7	U	
bis(2-Chloroethoxy)methane	0.485	0.485	0.55	µg/L	0.14	1.1	U	
bis(2-Chloroethyl) ether	0.0973	0.0972	0.115	µg/L	0.052	0.23	U	
Chlordane (technical)	0.0144	0.0132	0.05	µg/L	0.03	0.1	U	
Chrysene	0.0973	0.0972	0.115	µg/L	0.041	0.23	U	
Chromium VI	0.00500	0.00500	0.005	mg/L	0.0026	0.01	U	
Diazinon	0.481	0.481	0.5	µg/L	0.12	1	U	
Dibenz(a,h)anthracene	0.0973	0.0972	0.115	µg/L	0.04	0.23	U	
Dibenzofuran	0.485	0.485	0.55	µg/L	0.061	1.1	U	
Dicamba	1.00	1.00	1	µg/L	0.33	2	U	
Diethyl phthalate	0.485	0.485	0.55	µg/L	0.28	1.1	U	
Dimethyl phthalate	0.485	0.485	0.55	µg/L	0.048	1.1	U	
Di-n-butyl phthalate	0.485	0.485	0.55	µg/L	0.053	1.1	U	
Di-n-octyl phthalate	0.485	0.485	0.55	µg/L	0.049	1.1	U	
Dinoseb	0.3	0.3	0.3	µg/L	0.26	0.6	U	

Component Name	Mean	Geomean	Maximum	Units	MDL	RL	Qualifier	Sample
Hexachlorobenzene	0.0973	0.0972	0.115	µg/L	0.05	0.23	U	
Hexachlorobutadiene	0.0973	0.0972	0.115	µg/L	0.043	0.23	U	
Hexachlorocyclopentadiene	0.485	0.485	0.55	µg/L	0.091	1.1	U	
Hexachloroethane	0.485	0.485	0.55	µg/L	0.05	1.1	U	
Indeno(1,2,3-cd)pyrene	0.0973	0.0972	0.115	µg/L	0.054	0.23	U	
Isophorone	0.485	0.485	0.55	µg/L	0.054	1.1	U	
MCPA	200	200	200	µg/L	94	400	U	
MCPP	200	200	200	µg/L	130	400	U	
Methoxychlor	0.00289	0.00264	0.01	µg/L	0.0037	0.02	U	
Monobutyltin	0.245	0.244	0.29	µg/L	0.05	0.58	U	
Naphthalene	0.0973	0.0972	0.115	µg/L	0.049	0.23	U	
Nitrobenzene	0.0973	0.0972	0.115	µg/L	0.073	0.23	U	
N-Nitrosodimethylamine	0.485	0.485	0.55	µg/L	0.052	1.1	U	
N-Nitrosodi-n-propylamine	0.0973	0.0972	0.115	µg/L	0.068	0.23	U	
N-Nitrosodiphenylamine	0.0973	0.0972	0.115	µg/L	0.056	0.23	U	
Pentachlorophenol	0.485	0.485	0.55	µg/L	0.095	1.1	U	
Pyrene	0.0973	0.0972	0.115	µg/L	0.064	0.23	U	
Silver	2.50	2.50	2.5	µg/L	0.39	5	U	
Toxaphene	0.00150	0.00137	0.0055	µg/L	0.0031	0.011	U	

[1] Maximum value was <RL, but next highest value was >RL

Table B3. Dredging elutriate results – total (freshwater).

Component Name	Mean	Geomean	Maximum	Units	MDL	RL	Qualifier	Sample
Group I: Maximum Value Above RL								
4,4'-DDD	0.00144	0.00129	0.0028	µg/L	0.00037	0.0025	PG N	10_C3&4 - FN
Aldrin	0.00750	0.00477	0.013	µg/L	0.00053	0.0025	PG N	10_C3&4 - F
alpha-BHC	0.00198	0.00164	0.0049	µg/L	0.00074	0.0025		9_C2&4 - NN
Aluminum	7790	7670	9360	µg/L	6.1	150		10_C3&4 - F
Ammonia as Nitrogen	0.312	0.272	0.48	mg/L	0.0094	0.1		10_1 - NN
Arsenic	4.56	4.35	6	µg/L	0.7	5		10_1 - NN
Barium	159	159	177	µg/L	0.38	50		9_C2&4 - NN
Calcium	54300	51900	91400	µg/L	31.3	500	J	9_C2&4 - NN
Chromium	15.3	14.7	23.4	µg/L	0.56	10	J	10_C3&4 - F
Copper	11.6	11.5	14.4	µg/L	0.7	10	J	10_C3&4 - F
delta-BHC	0.00270	0.00183	0.0085	µg/L	0.00046	0.0025	PG N	9_C2&4 - NN
Endosulfan II	0.00615	0.00324	0.014	µg/L	0.00073	0.0025	PG	10_C3&4 - FN
gamma-BHC (Lindane)	0.00265	0.00227	0.0058	µg/L	0.00074	0.0025	PG	9_C2&4 - NN
Heptachlor	0.00719	0.00323	0.025	µg/L	0.00067	0.0025	PG N	10_1 - NN
Lead	8.46	8.25	10.5	µg/L	0.1	5		10_C3&4 - F
Nickel	10.9	10.8	14.5	µg/L	0.36	5		10_C3&4 - F
pH	8.02	8.02	8.2	No Units				10_C3&4 - FN
Total Organic Carbon	3.58	3.56	4	mg/L				10_C3&4 - F
Total Suspended Solids	149	135	246	mg/L	3.4	4		9_1 - NN
TPH (as Diesel)	88.4	77.1	150	µg/L	47	100	B	9_1 - NN
Chromium III	15.3	14.7	23.4	µg/L	0.27	2		10_C3&4 - F

Component Name	Mean	Geomean	Maximum	Units	MDL	RL	Qualifier	Sample
Zinc	63.9	60.4	107	µg/L	3	25	J	9_C2&4 - NN
Group II: Maximum Value <RL, Some Qualified Values Reported								
4,4'-DDE	0.00113	0.00109	0.00063	µg/L	0.00032	0.0025	J	9_1 - NN
4,4'-DDT	0.00140	0.00137	0.002	µg/L	0.00067	0.0025	J	10_1 - NN
Acenaphthene	0.0912	0.0902	0.066	µg/L	0.052	0.2	J	9_1 - NN
Antimony	4.34	4.03	1.7	µg/L	0.24	10	B	10_C3&4 - F
Aroclor 1254	0.0105	0.0101	0.016	µg/L	0.0044	0.019	J	10_1 - NN
Aroclors (Total)	0.0105	0.0101	0.016	µg/L	0.0057	0.019	J	10_1 - NN
Beryllium	2.17	1.82	2.9	µg/L	0.34	5	B	10_C3&4 - F
bis(2-Ethylhexyl) phthalate	0.515	0.481	0.91	µg/L	0.12	0.98	J	10_C3&4 - FN
Cadmium	2.58	2.58	2.9	µg/L	0.53	5	B	10_C3&4 - F
Cyanide, Total	4.56	4.45	5	µg/L	1.7	10	B J	9_1 - NN
Mercury	0.0866	0.0849	0.071	µg/L	0.055	0.2	B	9_1 - NN
Phenanthrene	0.104	0.0991	0.16	µg/L	0.055	0.2	J	9_1 - NN
Selenium	4.40	3.95	7.8	µg/L	1	25	B J	9_C2&4 - NN
Thallium	1.128	0.540	0.35	µg/L	0.09	5	B	10_C3&4 - F
TPH (as Gasoline)	47.0	45.7	56	µg/L	28	100	J	10_1 - NN
Group III: All Samples Non-Detect								
1,2,4-Trichlorobenzene	0.0980	0.0980	0.1	µg/L	0.039	0.2	U	
1,2-Dichlorobenzene	0.0980	0.0980	0.1	µg/L	0.031	0.2	U	
1,2-Diphenylhydrazine	0.0980	0.0980	0.1	µg/L	0.044	0.2	U	
1,3-Dichlorobenzene	0.0980	0.0980	0.1	µg/L	0.036	0.2	U	
1,4-Dichlorobenzene	0.0980	0.0980	0.1	µg/L	0.047	0.2	U	

Component Name	Mean	Geomean	Maximum	Units	MDL	RL	Qualifier	Sample
2,2'-oxybis(1-Chloropropane)	0.0980	0.0980	0.1	µg/L	0.025	0.2	U	
2,4,5-T	0.500	0.500	0.5	µg/L	0.17	1	U	
2,4,5-TP (Silvex)	0.500	0.500	0.5	µg/L	0.16	1	U	
2,4,6-Trichlorophenol	0.488	0.488	0.5	µg/L	0.057	1	U	
2,4-D	2.00	2.00	2	µg/L	1.5	4	U	
2,4-DB	2.00	2.00	2	µg/L	0.59	4	U	
2,4-Dichlorophenol	0.0980	0.0980	0.1	µg/L	0.048	0.2	U	
2,4-Dimethylphenol	0.488	0.488	0.5	µg/L	0.052	1	U	
2,4-Dinitrophenol	2.44	2.44	2.5	µg/L	1.3	5	U	
2,4-Dinitrotoluene	0.488	0.488	0.5	µg/L	0.045	1	U	
2,6-Dinitrotoluene	0.488	0.488	0.5	µg/L	0.051	1	U	
2-Chloronaphthalene	0.0980	0.0980	0.1	µg/L	0.043	0.2	U	
2-Chlorophenol	0.488	0.488	0.5	µg/L	0.045	1	U	
2-Methylnaphthalene	0.0980	0.0980	0.1	µg/L	0.046	0.2	U	
2-Nitrophenol	0.488	0.488	0.5	µg/L	0.054	1	U	
3,3'-Dichlorobenzidine	0.488	0.488	0.5	µg/L	0.041	1	U	
4,6-Dinitro-2-methylphenol	2.44	2.44	2.5	µg/L	1.4	5	U	
4-Bromophenyl phenyl ether	0.488	0.488	0.5	µg/L	0.05	1	U	
4-Chloro-3-methylphenol	0.488	0.488	0.5	µg/L	0.059	1	U	
4-Chlorophenyl phenyl ether	0.488	0.488	0.5	µg/L	0.043	1	U	
4-Methylphenol	0.488	0.488	0.5	µg/L	0.074	1	U	
4-Nitrophenol	2.44	2.44	2.5	µg/L	0.069	5	U	
Acenaphthylene	0.0980	0.0980	0.1	µg/L	0.045	0.2	U	

Component Name	Mean	Geomean	Maximum	Units	MDL	RL	Qualifier	Sample
alpha-Chlordane	0.00125	0.00125	0.00125	µg/L	0.00055	0.0025	U	
Anthracene	0.0980	0.0980	0.1	µg/L	0.05	0.2	U	
Aroclor 1016	0.00960	0.00960	0.01	µg/L	0.0049	0.02	U	
Aroclor 1221	0.00960	0.00960	0.01	µg/L	0.0049	0.02	U	
Aroclor 1232	0.00960	0.00960	0.01	µg/L	0.0057	0.02	U	
Aroclor 1242	0.00960	0.00960	0.01	µg/L	0.0036	0.02	U	
Aroclor 1248	0.00960	0.00960	0.01	µg/L	0.0045	0.02	U	
Aroclor 1260	0.00960	0.00960	0.01	µg/L	0.0027	0.02	U	
Benzidine	9.80	9.80	10	µg/L	5.5	20	U	
Benzo(a)anthracene	0.0980	0.0980	0.1	µg/L	0.04	0.2	U	
Benzo(a)pyrene	0.0980	0.0980	0.1	µg/L	0.043	0.2	U	
Benzo(b)fluoranthene	0.0980	0.0980	0.1	µg/L	0.031	0.2	U	
Benzo(ghi)perylene	0.0980	0.0980	0.1	µg/L	0.027	0.2	U	
Benzo(k)fluoranthene	0.0980	0.0980	0.1	µg/L	0.039	0.2	U	
Benzoic acid	2.44	2.44	2.5	µg/L	0.42	5	U	
beta-BHC	0.00125	0.00125	0.00125	µg/L	0.0007	0.0025	U	
bis(2-Chloroethoxy)methane	0.488	0.488	0.5	µg/L	0.12	1	U	
bis(2-Chloroethyl) ether	0.0980	0.0980	0.1	µg/L	0.045	0.2	U	
Butyl benzyl phthalate	0.488	0.488	0.5	µg/L	0.14	1	U	
Chlordane (technical)	0.012	0.012	0.012	µg/L	0.0072	0.024	U	
Chrysene	0.0980	0.0980	0.1	µg/L	0.035	0.2	U	
Chromium VI	0.05	0.05	0.05	mg/L	0.013	0.05	U G	
Dalapon	1.00	1.00	1	µg/L	0.52	2	U	

Component Name	Mean	Geomean	Maximum	Units	MDL	RL	Qualifier	Sample
Diazinon	0.483	0.483	0.49	µg/L	0.11	0.98	U	
Dibenz(a,h)anthracene	0.0980	0.0980	0.1	µg/L	0.034	0.2	U	
Dibenzofuran	0.488	0.488	0.5	µg/L	0.053	1	U	
Dibutyltin	0.0190	0.0190	0.0195	µg/L	0.01	0.039	U	
Dicamba	1.00	1.00	1	µg/L	0.33	2	U	
Dichlorprop	2.00	2.00	2	µg/L	0.72	4	U	
Dieldrin	0.00125	0.00125	0.00125	µg/L	0.00039	0.0025	U	
Diethyl phthalate	0.488	0.488	0.5	µg/L	0.24	1	U	
Dimethyl phthalate	0.488	0.488	0.5	µg/L	0.042	1	U	
Di-n-butyl phthalate	0.488	0.488	0.5	µg/L	0.046	1	U	
Di-n-octyl phthalate	0.488	0.488	0.5	µg/L	0.043	1	U	
Dinoseb	0.300	0.300	0.3	µg/L	0.26	0.6	U	
Endosulfan I	0.00125	0.00125	0.00125	µg/L	0.00036	0.0025	U	
Endosulfan sulfate	0.00125	0.00125	0.00125	µg/L	0.00077	0.0025	U	
Endrin	0.00125	0.00125	0.00125	µg/L	0.00037	0.0025	U	
Endrin aldehyde	0.00125	0.00125	0.00125	µg/L	0.00058	0.0025	U	
Fluoranthene	0.0980	0.0980	0.1	µg/L	0.048	0.2	U	
Fluorene	0.0980	0.0980	0.1	µg/L	0.053	0.2	U	
gamma-Chlordane	0.00125	0.00125	0.00125	µg/L	0.00037	0.0025	U	
Heptachlor epoxide	0.00125	0.00125	0.00125	µg/L	0.00048	0.0025	U	
Hexachlorobenzene	0.0980	0.0980	0.1	µg/L	0.043	0.2	U	
Hexachlorobutadiene	0.0980	0.0980	0.1	µg/L	0.037	0.2	U	
Hexachlorocyclopentadiene	0.488	0.488	0.5	µg/L	0.08	1	U	

Component Name	Mean	Geomean	Maximum	Units	MDL	RL	Qualifier	Sample
Hexachloroethane	0.488	0.488	0.5	µg/L	0.043	1	U	
Indeno(1,2,3-cd)pyrene	0.0980	0.0980	0.1	µg/L	0.047	0.2	U	
Isophorone	0.488	0.488	0.5	µg/L	0.047	1	U	
MCPA	200	200	200	µg/L	94	400	U	
MCPP	200	200	200	µg/L	130	400	U	
Methoxychlor	0.00241	0.00241	0.00245	µg/L	0.0009	0.0049	U	
Monobutyltin	0.247	0.247	0.255	µg/L	0.05	0.51	U	
Naphthalene	0.0980	0.0980	0.1	µg/L	0.042	0.2	U	
Nitrobenzene	0.0980	0.0980	0.1	µg/L	0.063	0.2	U	
N-Nitrosodimethylamine	0.488	0.488	0.5	µg/L	0.045	1	U	
N-Nitrosodi-n-propylamine	0.0980	0.0980	0.1	µg/L	0.058	0.2	U	
N-Nitrosodiphenylamine	0.0980	0.0980	0.1	µg/L	0.048	0.2	U	
Pentachlorophenol	0.488	0.488	0.5	µg/L	0.083	1	U	
Phenol	0.0980	0.0980	0.1	µg/L	0.022	0.2	U	
Pyrene	0.0980	0.0980	0.1	µg/L	0.055	0.2	U	
Silver	2.50	2.50	2.5	µg/L	0.39	5	U	
Tetrabutyltin	0.0247	0.0247	0.0255	µg/L	0.0086	0.051	U	
Tin	12.5	12.5	12.5	µg/L	3.8	25	U	
Toxaphene	0.00125	0.00125	0.00125	µg/L	0.00073	0.0025	U	
Tributyltin	0.0220	0.0220	0.023	µg/L	0.012	0.046	U	

Table B4. Dredging elutriate results – total (marine).

Component Name	Mean	Geomean	Maximum	Units	MDL	RL	Qualifier	Sample
Group I: Maximum Value Above RL								
4,4'-DDD	0.00179	0.00158	0.0067	µg/L	0.00039	0.0026	PG	6_6 - F
4,4'-DDE[1]	0.00155	0.00135	0.0039	µg/L	0.00032	0.0025	PG	3_C1_3 - F
4,4'-DDT	0.00181	0.00155	0.0074	µg/L	0.00069	0.0026		6_6 - F
Aldrin	0.00719	0.00390	0.027	µg/L	0.0022	0.011		8_C1_4 - NN
alpha-BHC	0.00200	0.00155	0.021	µg/L	0.00074	0.0025	PG N	6_4 - FN
alpha-Chlordane	0.00201	0.00162	0.011	µg/L	0.00055	0.0025	PG N	6_4 - FN
Aluminum	5950	5720	11600	µg/L	6.1	150		5_7_ - NN
Ammonia as Nitrogen	0.352	0.319	1.1	mg/L	0.0094	0.1		10_C1_6 - NN
Aroclor 1248	0.0135	0.0113	0.077	µg/L	0.0044	0.019		5_4 - NN
Aroclor 1254[1]	0.0117	0.0107	0.022	µg/L	0.0044	0.019		5_4 - NN
Aroclors (Total)	0.0141	0.0113	0.098	µg/L	0.0056	0.019		5_4 - NN
Arsenic	6.99	6.67	11.8	µg/L	0.7	5		6_4 - FN
Barium	174	170	281	µg/L	0.38	50	J	10_C1_6 - NN
beta-BHC	0.0113	0.00283	0.079	µg/L	0.0007	0.0025	PG N	4/5_6 - N
bis(2-Ethylhexyl) phthalate	0.603	0.456	2	µg/L	0.11	0.95		4/5_13 - N
Cadmium	2.03	1.77	5.8	µg/L	0.53	5		7_C1_9 - N
Calcium	125000	124000	154000	µg/L	31.3	500		7_4 - NN
Chromium	13.5	13.2	18.5	µg/L	0.56	10	J	6_4 - F
Copper	10.2	9.69	23	µg/L	0.7	10		5_8 - NN
Chromium VI	0.0220	0.0103	0.18	mg/L	0.0026	0.01		3_C4_6 - N
delta-BHC	0.0134	0.00262	0.39	µg/L	0.00046	0.0025	PG N	6_4 - FN

Component Name	Mean	Geomean	Maximum	Units	MDL	RL	Qualifier	Sample
Dibutyltin	0.0321	0.0240	0.25	µg/L	0.01	0.039		4/5_5 - N
Dieldrin	0.00158	0.00137	0.0059	µg/L	0.0004	0.0026		6_6 - F
Endosulfan II	0.00862	0.00364	0.064	µg/L	0.00073	0.0025	PG N	4/5_8 - N
Endosulfan sulfate[1]	0.00160	0.00142	0.0054	µg/L	0.0008	0.0026	PG N	6_5 - FN
Fluoranthene	0.100	0.0987	0.21	µg/L	0.048	0.19		4_6 - NN
gamma-BHC (Lindane)	0.00287	0.00229	0.012	µg/L	0.00074	0.0025	PG N	6_4 - FN
gamma-Chlordane	0.00257	0.00197	0.02	µg/L	0.00037	0.0025	PG N	6_4 - FN
Heptachlor	0.00910	0.00466	0.043	µg/L	0.00067	0.0025	PG N	5_7_ - NN
Heptachlor epoxide	0.00233	0.00167	0.027	µg/L	0.00047	0.0025	PG N	3_C1_3 - F
Lead	8.36	7.21	25.5	µg/L	0.1	5		5_8 - NN
Nickel	8.88	8.63	14.4	µg/L	0.36	5		6_4 - F
pH	7.87	7.86	8.7	No Units				5_7_ - NN
Selenium	33.7	30.8	58.2	µg/L	1	25	J	6_5 - F
Tetrabutyltin	0.0257	0.0253	0.069	µg/L	0.0086	0.051	P	8_C1_4 - NN
Total Organic Carbon	2.81	2.80	3.3	mg/L				6_2 - NN
Total Suspended Solids	147	118	427	mg/L	3.4	4		6_6 - F
TPH (as Diesel)	89.5	77.8	230	µg/L	47	100		7_2 - NN
Tributyltin	0.0315	0.0251	0.26	µg/L	0.012	0.043		4_4 - NN
Chromium III	12.9	12.3	18.5	µg/L	0.27	2		6_4 - F
Zinc	42.2	38.8	110	µg/L	3	25	J	5_8 - NN
Group II: Maximum Value <RL, Some Qualified Values Reported								
2-Methylnaphthalene	0.0976	0.0976	0.079	µg/L	0.045	0.19	J	7_9 - F
4-Methylphenol	0.482	0.474	0.089	µg/L	0.073	0.99	J	7_6 - F

Component Name	Mean	Geomean	Maximum	Units	MDL	RL	Qualifier	Sample
Acenaphthene	0.0967	0.0965	0.089	µg/L	0.052	0.2	J	5_C1_3 - NN
Anthracene	0.0967	0.0963	0.079	µg/L	0.049	0.19	J	4_6 - NN
Antimony	2.13	1.51	3.8	µg/L	0.24	10	B	7_2 - NN
Benzo(a)anthracene	0.0973	0.0972	0.068	µg/L	0.041	0.2	J	7_6 - F
Benzo(a)pyrene	0.0974	0.0972	0.07	µg/L	0.043	0.2	J	7_6 - F
Beryllium	1.78	1.64	4.7	µg/L	0.34	5	B	7_C1_9 - N
Butyl benzyl phthalate	0.471	0.460	0.18	µg/L	0.14	0.98	J	6_3 - FN
Chrysene	0.0973	0.0971	0.067	µg/L	0.035	0.2	J	7_6 - F
Cyanide, Total	3.92	3.65	3	µg/L	1.7	10	B J	6_3 - FN
Dalapon	0.989	0.988	1	µg/L	0.52	2	J COL	4_4 - NN
Dibenzofuran	0.481	0.470	0.062	µg/L	0.053	0.99	J	5_C1_3 - NN
Di-n-butyl phthalate	0.474	0.456	0.099	µg/L	0.046	0.99	J	7_6 - F
Endrin	0.00149	0.00135	0.0026	µg/L	0.00038	0.0026		6_6 - F
Fluorene	0.0983	0.0982	0.12	µg/L	0.053	0.19	J	4_6 - NN
Indeno(1,2,3-cd)pyrene	0.0971	0.0968	0.056	µg/L	0.047	0.2	J	7_6 - F
MCPA	199	198	130	µg/L	94	400	J	5_5 - NN
Mercury	0.0939	0.0928	0.098	µg/L	0.055	0.2	B	6_5 - FN
Phenanthrene	0.0997	0.0986	0.17	µg/L	0.053	0.19	J	4_6 - NN
Pyrene	0.0970	0.0962	0.15	µg/L	0.055	0.19	J	4_6 - NN
Thallium	0.933	0.516	1.8	µg/L	0.09	5	B J	3_C1_3 - FN
Tin	11.6	11.2	15.4	µg/L	3.8	25	B	3_C1_3 - FN
TPH (as Gasoline)	42.3	40.9	91	µg/L	28	100	J	3_C4_6 - N
Group III: All Samples Non-Detect								

Component Name	Mean	Geomean	Maximum	Units	MDL	RL	Qualifier	Sample
1,2,4-Trichlorobenzene	0.0979	0.0979	0.105	µg/L	0.041	0.21	U	
1,2-Dichlorobenzene	0.0979	0.0979	0.105	µg/L	0.032	0.21	U	
1,2-Diphenylhydrazine	0.0979	0.0979	0.105	µg/L	0.046	0.21	U	
1,3-Dichlorobenzene	0.0979	0.0979	0.105	µg/L	0.038	0.21	U	
1,4-Dichlorobenzene	0.0979	0.0979	0.105	µg/L	0.05	0.21	U	
2,2'-oxybis(1-Chloropropane)	0.0979	0.0979	0.105	µg/L	0.027	0.21	U	
2,4,5-T	0.500	0.500	0.5	µg/L	0.17	1	U	
2,4,5-TP (Silvex)	0.500	0.500	0.5	µg/L	0.16	1	U	
2,4,6-Trichlorophenol	0.490	0.490	0.5	µg/L	0.057	1	U	
2,4-D	2.00	2.00	2	µg/L	1.5	4	U	
2,4-DB	2.00	2.00	2	µg/L	0.59	4	U	
2,4-Dichlorophenol	0.0979	0.0979	0.105	µg/L	0.05	0.21	U	
2,4-Dimethylphenol	0.490	0.490	0.5	µg/L	0.052	1	U	
2,4-Dinitrophenol	2.45	2.45	2.6	µg/L	1.3	5.2	U	
2,4-Dinitrotoluene	0.490	0.490	0.5	µg/L	0.045	1	U	
2,6-Dinitrotoluene	0.490	0.490	0.5	µg/L	0.051	1	U	
2-Chloronaphthalene	0.0979	0.0979	0.105	µg/L	0.046	0.21	U	
2-Chlorophenol	0.490	0.490	0.5	µg/L	0.045	1	U	
2-Nitrophenol	0.490	0.490	0.5	µg/L	0.054	1	U	
3,3'-Dichlorobenzidine	0.490	0.490	0.5	µg/L	0.041	1	U	
4,6-Dinitro-2-methylphenol	2.45	2.45	2.6	µg/L	1.5	5.2	U	
4-Bromophenyl phenyl ether	0.490	0.490	0.5	µg/L	0.05	1	U	
4-Chloro-3-methylphenol	0.490	0.490	0.5	µg/L	0.059	1	U	

Component Name	Mean	Geomean	Maximum	Units	MDL	RL	Qualifier	Sample
4-Chlorophenyl phenyl ether	0.490	0.490	0.5	µg/L	0.043	1	U	
4-Nitrophenol	2.45	2.45	2.6	µg/L	0.072	5.2	U	
Acenaphthylene	0.0979	0.0979	0.105	µg/L	0.048	0.21	U	
Aroclor 1016	0.0114	0.0105	0.0405	µg/L	0.02	0.081	U	
Aroclor 1221	0.0114	0.0105	0.0405	µg/L	0.02	0.081	U	
Aroclor 1232	0.0114	0.0105	0.0405	µg/L	0.024	0.081	U	
Aroclor 1242	0.0114	0.0105	0.0405	µg/L	0.015	0.081	U	
Aroclor 1260	0.0114	0.0105	0.0405	µg/L	0.011	0.081	U	
Benzidine	9.79	9.79	10.5	µg/L	5.8	21	U	
Benzo(b)fluoranthene	0.0979	0.0979	0.105	µg/L	0.032	0.21	U	
Benzo(ghi)perylene	0.0979	0.0979	0.105	µg/L	0.028	0.21	U	
Benzo(k)fluoranthene	0.0979	0.0979	0.105	µg/L	0.041	0.21	U	
Benzoic acid	2.45	2.45	2.6	µg/L	0.44	5.2	U	
bis(2-Chloroethoxy)methane	0.490	0.490	0.5	µg/L	0.12	1	U	
bis(2-Chloroethyl) ether	0.0979	0.0979	0.105	µg/L	0.047	0.21	U	
Chlordane (technical)	0.0143	0.0131	0.05	µg/L	0.03	0.1	U	
Diazinon	0.486	0.486	0.5	µg/L	0.12	1	U	
Dibenz(a,h)anthracene	0.0979	0.0979	0.105	µg/L	0.036	0.21	U	
Dicamba	1.00	1.00	1	µg/L	0.33	2	U	
Dichlorprop	2.00	2.00	2	µg/L	0.72	4	U	
Diethyl phthalate	0.490	0.490	0.5	µg/L	0.24	1	U	
Dimethyl phthalate	0.490	0.490	0.5	µg/L	0.042	1	U	
Di-n-octyl phthalate	0.490	0.490	0.5	µg/L	0.043	1	U	

Component Name	Mean	Geomean	Maximum	Units	MDL	RL	Qualifier	Sample
Dinoseb	0.3	0.3	0.3	µg/L	0.26	0.6	U	
Endosulfan I	0.00150	0.00137	0.0055	µg/L	0.0015	0.011	U	
Endrin aldehyde	0.00150	0.00137	0.0055	µg/L	0.0024	0.011	U	
Hexachlorobenzene	0.0979	0.0979	0.105	µg/L	0.045	0.21	U	
Hexachlorobutadiene	0.0979	0.0979	0.105	µg/L	0.039	0.21	U	
Hexachlorocyclopentadiene	0.490	0.490	0.5	µg/L	0.08	1	U	
Hexachloroethane	0.490	0.490	0.5	µg/L	0.043	1	U	
Isophorone	0.490	0.490	0.5	µg/L	0.047	1	U	
MCPP	200	200	200	µg/L	130	400	U	
Methoxychlor	0.00286	0.00263	0.01	µg/L	0.0037	0.02	U	
Monobutyltin	0.248	0.248	0.285	µg/L	0.05	0.57	U	
Naphthalene	0.0979	0.0979	0.105	µg/L	0.044	0.21	U	
Nitrobenzene	0.0979	0.0979	0.105	µg/L	0.066	0.21	U	
N-Nitrosodimethylamine	0.490	0.490	0.5	µg/L	0.045	1	U	
N-Nitrosodi-n-propylamine	0.0979	0.0979	0.105	µg/L	0.061	0.21	U	
N-Nitrosodiphenylamine	0.0979	0.0979	0.105	µg/L	0.05	0.21	U	
Pentachlorophenol	0.490	0.490	0.5	µg/L	0.083	1	U	
Phenol	0.0979	0.0979	0.105	µg/L	0.023	0.21	U	
Silver	2.50	2.50	2.5	µg/L	0.39	5	U	
Toxaphene	0.00150	0.00137	0.0055	µg/L	0.0031	0.011	U	

[1] Maximum value was <RL, but next highest value was >RL

Table B5. Dredging elutriate data validation rejects.

Sample	Compound	Phase
3_C1_3 - FN	Dibutyltin	Total
3_C1_3 - FN	Monobutyltin	Total
3_C1_3 - FN	Tetrabutyltin	Total
3_C1_3 - FN	Tributyltin	Total
6_6 - F	Dicamba	Dissolved
6_6 - F	Dinoseb	Dissolved
6_4 - FN	Dicamba	Dissolved
6_4 - FN	Dinoseb	Dissolved
6_4 -F N	Monobutyltin	Dissolved
6_4 - FN	Monobutyltin	Total
6_5 - FN	Monobutyltin	Dissolved
6_6 - FN	Monobutyltin	Dissolved
7_C1_9 - N	Monobutyltin	Dissolved
10_1 - NN	Monobutyltin	Dissolved
10_1 - NN	Endrin aldehyde	Total
10_1 - NN	Monobutyltin	Total
10_C3&4 - F	Monobutyltin	Total

Table B6. Distance to compliance with (marine) water quality criteria - marine dredging elutriate.

Location of Maximum Concentration	Contaminant	Acute WQS (µg/L)	Chronic WQS (µg/L)	Bulk Sediment Concentration (mg/kg)	Initial Elutriate TSS Concentration (kg/L)	Maximum Elutriate Concentration			Fraction Dissolved	Partitioning Coefficient	Distance to Compliance with Criteria			
											0 m Above Bottom		1 m Above Bottom	
						Dissolved (µg/L)	Total (µg/L)	Solids Associated (µg/mg)		K_d (L/kg)	Acute (m)	Chronic (m)	Acute (m)	Chronic (m)
5_6 - NN	4,4'-DDD	0.03	0.006	0.037	0.01	0.0019	0.37	3.68E-05	0.005	19400	<1	<1	<1	<1
3_C1_3 - F	4,4'-DDT	0.13	0.001	0.0012	0.01	0.0031	0.012	8.90E-07	0.258	287	<1	<9	<1	<1
2_C1_6 - NN	Acenaphthene	970	710	0.2	0.01	0.058	2	1.94E-04	0.029	3350	<1	<1	<1	<1
10_C1_6 - NN	Aldrin	1.3		0.0061	0.01	0.039	0.061	2.20E-06	0.639	56.4	<1	N/A	<1	N/A
3_C1_3 - F	alpha-Chlordane	0.09	0.004	0.0008	0.01	0.0044	0.008	3.60E-07	0.550	81.8	<1	<2	<1	<1
5_6 - NN	Aroclors (Total)	2	0.014	0.71	0.01	4.7	7.1	2.40E-04	0.662	51.1	<4	<350	<1	<350
10_C1_6 - NN	Arsenic	69	36	9.4	0.01	12.7	94	8.13E-03	0.135	640	<1	<1	<1	<1
6_4 - FN	Cadmium	40	1.57	0.53	0.01	1.5	5.3	3.80E-04	0.283	253	<1	<2	<1	<1
7_5 - F	Chromium III	310	103	12.4	0.01	9.8	124	1.14E-02	0.079	1170	<1	<1	<1	<1
6_2 - NN	Copper	3.63	3.1	16.6	0.01	5.5	166	1.61E-02	0.033	2918	<15	<22	<9	<14
6_2 - NN	Cyanide, Total	1	1	0.385	0.01	63.6	3.85	-5.98E-03	1.000	0.0	<7	<7	<25	<25
3_C1_3 - F	Dieldrin	0.2374	0.0019	0.0011	0.01	0.0021	0.011	8.90E-07	0.191	424	<1	<2	<1	<1
6_6 - F	Endosulfan I	0.034	0.0087	0.00016	0.01	0.0018	0.0016	-2.00E-08	1.000	0.0	<1	<1	<1	<1
6_2 - N	Endosulfan II	0.034	0.0087	0.00074	0.01	0.019	0.0074	-1.16E-06	1.000	0.0	<1	<1	<1	<1
3_C1_3 - F	Endrin	0.037	0.0023	0.0008	0.01	0.0085	0.008	-5.00E-08	1.000	0.0	<1	<4	<1	<1
7_9 - F	gamma-BHC (Lindane)	0.16		0.00155	0.01	0.0095	0.0155	6.00E-07	0.613	63.2	<1	N/A	<1	N/A

Location of Maximum Concentration	Contaminant	Acute WQS (µg/L)	Chronic WQS (µg/L)	Bulk Sediment Concentration (mg/kg)	Initial Elutriate TSS Concentration (kg/L)	Maximum Elutriate Concentration			Fraction Dissolved	Partitioning Coefficient	Distance to Compliance with Criteria			
											0 m Above Bottom		1 m Above Bottom	
						Dissolved (µg/L)	Total (µg/L)	Solids Associated (µg/mg)		K_d (L/kg)	Acute (m)	Chronic (m)	Acute (m)	Chronic (m)
6_2 - N	gamma-Chlordane	0.09	0.004	0.00085	0.01	0.0084	0.0085	1.00E-08	0.988	1.19	<1	<3	<1	<1
7_4 - NN	Heptachlor	0.053	0.0036	0.0105	0.01	0.053	0.105	5.20E-06	0.505	98.1	<2	<26	<1	<20
3_C1_3 - F	Heptachlor epoxide	0.053	0.0036	0.0008	0.01	0.028	0.008	-2.00E-06	1.000	0.0	<1	<3	<1	<1
7_6 - F	Lead	30	1.2	17.4	0.01	1.4	174	1.73E-02	0.008	12300	<1	<19	<1	<12
3_C1_3 - FN	Mercury	1.8	0.012	0.045	0.01	0.067	0.45	3.83E-05	0.149	572	<1	<26	<1	<19
6_6 - FN	Nickel	74	8.2	19.4	0.01	59.5	194	1.35E-02	0.307	226	<1	<20	<1	<14
7_5 - F	Phenol	580	290	0.0033	0.01	0.27	0.033	-2.37E-05	1.000	0.0	<1	<1	<1	<1
10_C1_6 - NN	Selenium	290	71	2.3	0.01	57.2	23	-3.42E-03	1.000	0.0	<1	<1	<1	<1
3_C1_3 - FN	Thallium	2130		0.23	0.01	1.9	2.3	4.00E-05	0.826	21.1	<1	N/A	<1	N/A
4_4 - NN	Tributyltin	0.42	0.0074	0.08	0.01	0.24	0.8	5.60E-05	0.300	233	<1	<80	<1	<60
3_C4_6 - N	Zinc	64	58	56.1	0.01	43.4	561	5.18E-02	0.077	1190	<1	<1	<1	<1

Table B7. Distance to compliance with (freshwater) water quality criteria - freshwater dredging elutriate.

Location of Maximum Concentration	Contaminant	Acute WQS (µg/L)	Chronic WQS (µg/L)	Bulk Sediment Concentration (mg/kg)	Initial Elutriate TSS Concentration (kg/L)	Maximum Elutriate Concentration			Fraction Dissolved	Partitioning Coefficient	Distance to Compliance with Criteria			
											0 m Above Bottom		1 m Above Bottom	
						Dissolved (µg/L)	Total (µg/L)	Solids Associated (µg/mg)		Kd (L/kg)	Acute (m)	Chronic (m)	Acute (m)	Chronic (m)
10_C3&4 - FN	Arsenic	339.8	150	5.3	0.01	4.2	53	0.005	0.079	1162	<1	<1	<1	<1
9_1 - NN	Chromium III	570	74	18.7	0.01	7.5	187	0.018	0.040	2393	<1	<1	<1	<1
10_C3&4 - FN	Copper	13	9	18.4	0.01	4.7	184	0.018	0.026	3815	<1	<1	<1	<1
10_C3&4 - FN	Lead	65	2.5	14.4	0.01	1.8	144	0.014	0.013	7900	<1	<1	<1	<1
9_C2&4 - NN	Mercury	1.4	0.012	0.073	0.01	0.059	0.73	0.000	0.081	1137	<1	<38	<1	<28
10_C3&4 - FN	Nickel	470	52	21.4	0.01	3.2	214	0.021	0.015	6588	<1	<1	<1	<1
9_C2&4 - NN	Selenium	20	5	1.2	0.01	10.1	12	0.000	0.842	19	<1	<1	<1	<1
9_C2&4 - NN	Thallium	110	12	0.28	0.01	0.2	2.8	0.000	0.071	1300	<1	<1	<1	<1
10_C3&4 - F	Zinc	120	120	38.9	0.01	17.3	389	0.037	0.044	2149	<1	<1	<1	<1
9_1 - NN	Cyanide, Total	22	5.2	0.16	0.01	5.5	1.6	0.000	1.000	0	<1	<1	<1	<1
9_C2&4 - NN	gamma-BHC (Lindane)	0.95	0.21	0.0008	0.01	0.0066	0.008	0.000	0.825	21	<1	<1	<1	<1
10_C3&4 - FN	gamma-Chlordane	2.4	0.0043	0.000165	0.01	0.0025	0.00165	0.000	1.000	0	<1	<1	<1	<1
9_C2&4 - NN	4,4'-DDD	0.03	0.006	0.002	0.01	0.00056	0.02	0.000	0.028	3471	<1	<1	<1	<1
10_1 - NN	4,4'-DDT	1.1	0.001	0.00165	0.01	0.0023	0.0165	0.000	0.139	617	<1	<10	<1	<1
10_1 - NN	Endrin	0.086	0.036	0.00165	0.01	0.0011	0.0165	0.000	0.067	1400	<1	<1	<1	<1
10_1 - NN	Heptachlor	0.52	0.0038	0.00165	0.01	0.047	0.0165	0.000	1.000	0	<1	<5	<1	<1

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14. ABSTRACT

The U.S. Army Corps of Engineers, New Orleans District has been authorized by Congress to replace the existing Industrial Canal Lock. The existing lock has been in operation since 1921, and a new, larger lock would accommodate a heavier traffic load and modern deep-draft vessels. As part of the construction project, sediment and soil from the area will be dredged to accommodate the new lock, allow ship traffic to bypass the construction site, and deepen the current channel through the Inner Harbor Navigation Canal (IHNC). This document summarizes the sediment characterization and environmental analysis conducted in support of the IHNC lock replacement dredging project.

15. SUBJECT TERMS		
Confined disposal facility (CDF) Dredged Material disposal	Dredging Inner Harbor Navigation Canal (IHNC)	

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